Standard Size, 9 x 12. DECEMBER 25, 1902. Price Ten Cents.

PUBLIC LIBRARY
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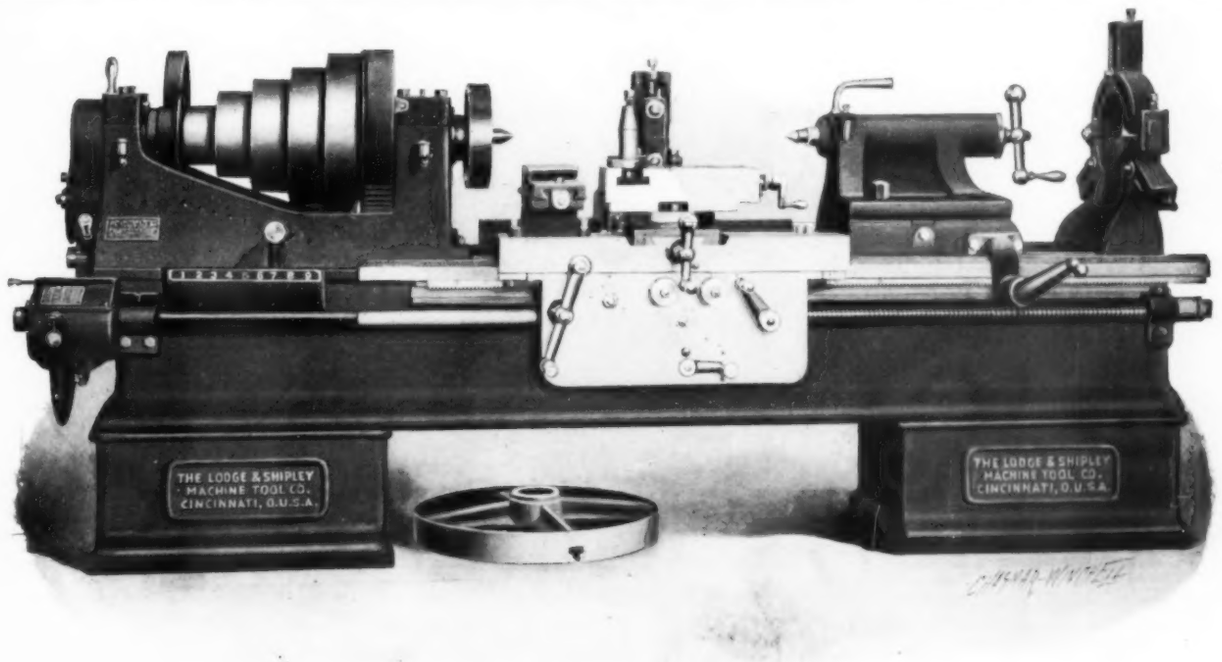
OF DETR

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.
ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY,
WORLD BUILDING, NEW YORK.
Vol. 25. No. 52.

Index to Advertisers and Classified Index Following Reading Matter.



TOOL STEEL LIMIT.

Will the lathes you are operating get out of the latest and best tool steel all it will stand? We make lathes that will. One tool steel was recently tested up to 176′ of cutting speed per minute on one of our lathes.
SIZES: 14 inch swing to 48 inch swing.

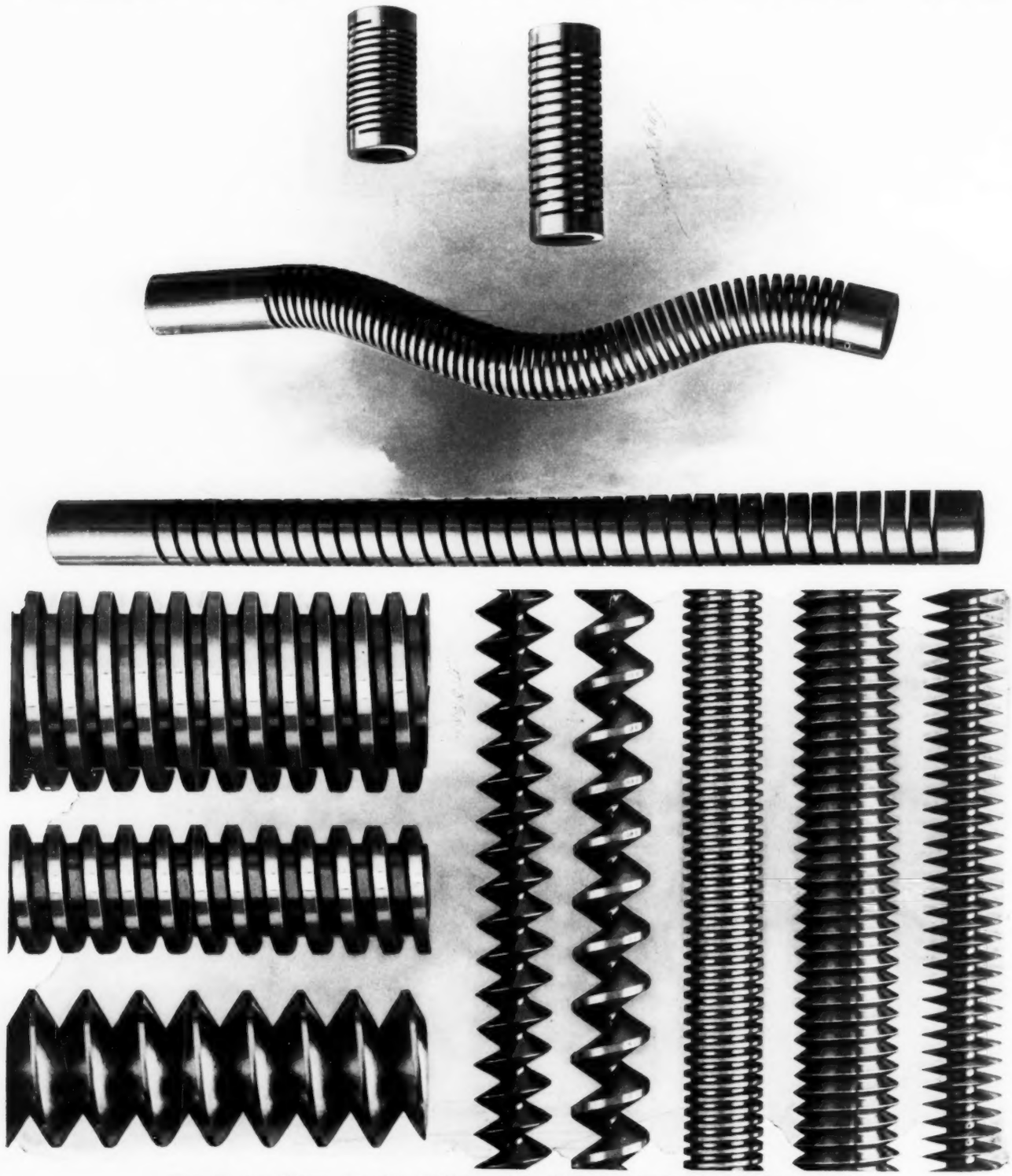
The

Lodge & Shipley Machine Tool Co.

CINCINNATI, OHIO, U.S.A.

SAMPLES OF WORK FROM

P.&W. THREAD MILLING MACHINE



Send to New York Office for Illustrated Booklet "A."

PRATT & WHITNEY CO.

136-138 Liberty St., New York. **WORKS: HARTFORD, CONN.**

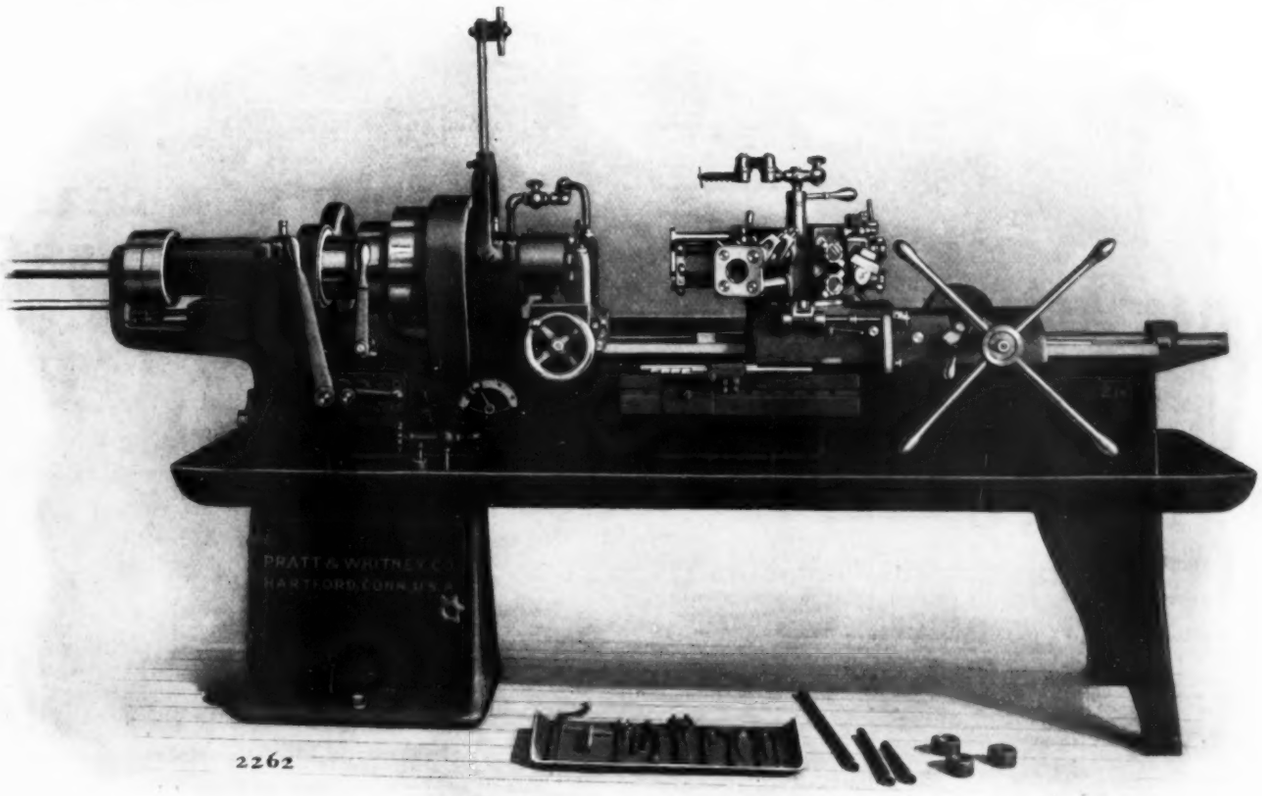
OFFICES:

Boston: 144 Pearl St. Philadelphia: 21st and Callowhill Sts. Pittsburgh: Frick Building. Chicago: 46 South Canal St.
St. Louis: 516 North 3rd St. Dayton: 152 Salem St.

NEW MODEL
TURRET LATHES

Built in Five Sizes:

5-8x4 1-2″ 1x10″ 1 1-2x18″ 2x26″ 3 1-8x36″



2x26-inch New Model Turret Lathe.

THE IMPROVEMENTS incorporated in the "New Model" Turret Lathes make possible greater accuracy, capacity, convenience and durability. It has been demonstrated that these machines can be set up for given work in less time and with less expense for tools than any other machines of this class.

The above illustration shows machine equipped with multiple tool with two tangent cutters, a multiple tool with two radial cutters and a squaring and recessing tool. Send to New York office for illustrated booklet.

Pratt & Whitney Co.,

136-138 Liberty St., New York. Works: Hartford, Conn., U.S.A.

OFFICES:

Boston: 144 Pearl St. Philadelphia: 21st and Callowhill Sts. Pittsburgh: Frick Building. Chicago: 46 South Canal St.
St. Louis: 516 North 3rd St. Dayton: 152 Salem St.

THE STORY OF THE FLAT TURRET LATHE

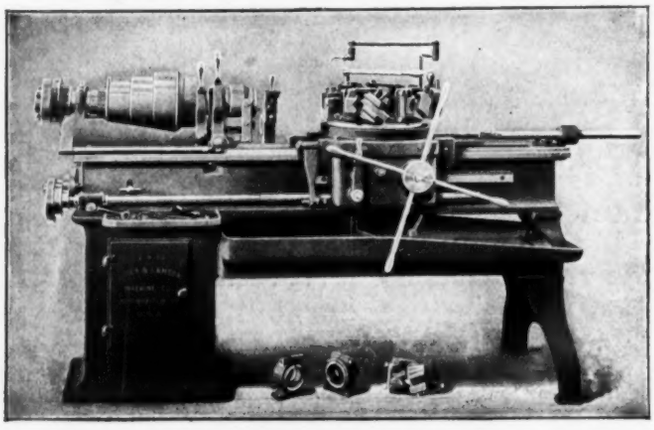
TOLD IN A DOZEN OR SO CHAPTERS.

CHAPTER TWENTY-FOUR.

About Resolutions.

Presently the time will arrive when people "resolve" things for the new year, "resolve" to do or not to do, this, that, or the other.

A resolution which could stand at the head of all others—so far as applies to you—might be, a resolution to install a "Flat Turret" Lathe as soon as fast freight can get it to you; to the end that at the close of the coming year your bank balance take on a healthier and weightier look, and that old man, Possible Deficieny, be chased to the thick woods.



Remember, you are asked to install the "Flat Turret" for your own good; we win once, you win all the time. You take no chances, there is no gamble in the "Flat Turret" proposition so far as you are concerned.

The "Flat Turret" comes onto the floor of your shop guaranteed to a certain performance and a certain saving, amounting to from 50% to 80% on certain kinds of work. If it fails in the guarantee, you are not asked or expected to keep it.

The "Flat Turret" takes any length rods, of any shape, rough or finished, and produces work coming within 2″ diameter by 24″ long in duplicate, down to as few as six to ten pieces, and affords a saving averaging 70%.

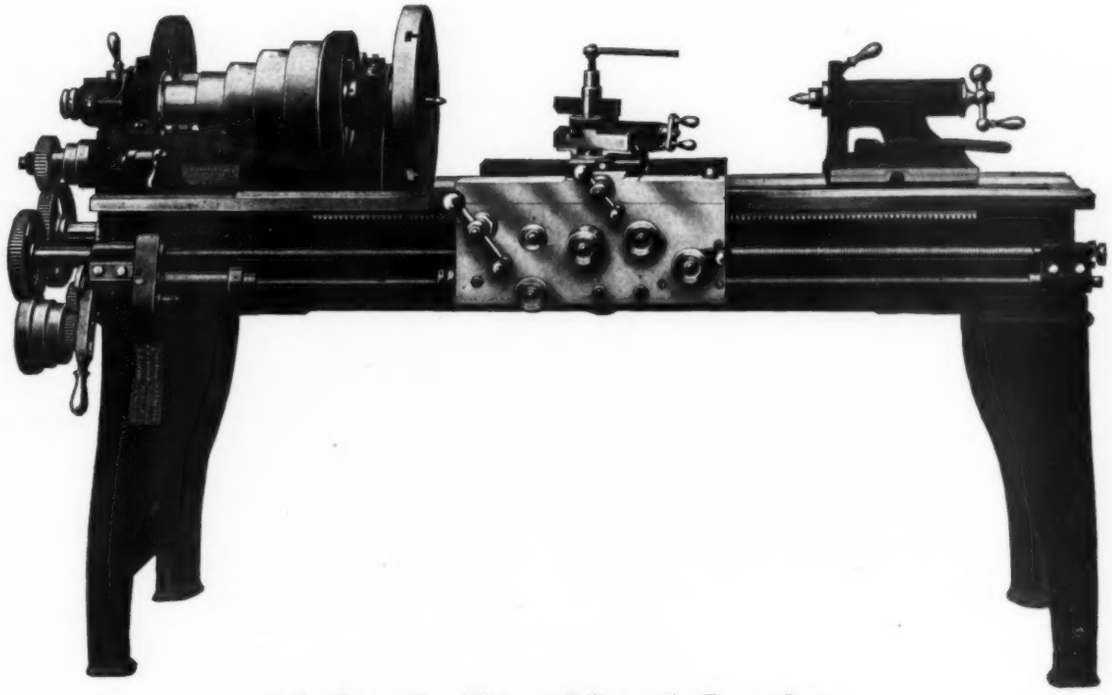
Treatise on the "Flat Turret" comes on request.

JONES & LAMSON MACHINE CO.,

SPRINGFIELD, VERMONT, U. S. A.

ENGLISH OFFICE: Jones & Lamson Machine Co., Exchange Buildings, Stephenson's Place, Birmingham, England.
Germany, Holland, Belgium, Switzerland, Austria-Hungary and Italy: M. Koyemann, Charlottenstrasse 112, Dusseldorf, Germany.
France and Spain: Ph. Bonvillain, 6, Rue Blanche, 6, Paris, France.

Lathes, 14 to 36 Inch.



14-Inch Bradford Lathe.

This 14-Inch Lathe is a convenient and accurate machine for the tool room. The highest class of skilled labor is put on these lathes, and on work of a specific nature the degree of accuracy obtained from them is as near perfection as is possible to attain. These lathes, when so ordered, are also supplied with our

Improved Taper Turning Attachment, Draw-in Attachment, Wire Chucks, Oil Pans, Etc.

SPECIAL DESCRIPTIVE CIRCULARS MAILED ON APPLICATION.

Bradford Machine Tool Co.,

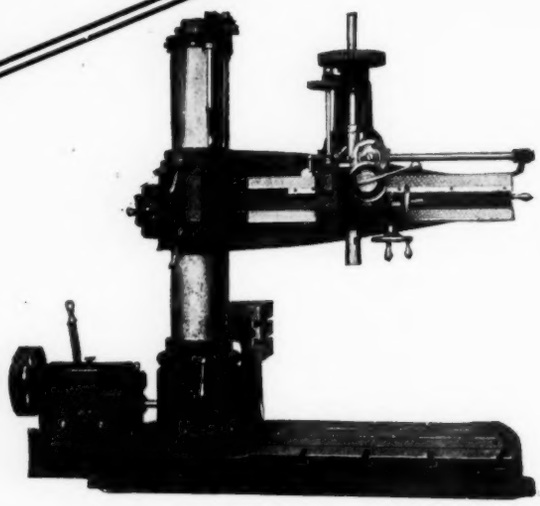
Cincinnati, O., U.S.A.

Pacific Tool & Supply Co., San Francisco, Cal., Agents for Pacific Coast.
Foreign Agents.—Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Glasgow, Newcastle-on-Tyne.
Schuchardt & Schutte, Berlin, Cologne, Vienna, St. Petersburg, Brussels, Stockholm.

FEW RADIAL DRILL DESIGNERS of to-day realize that the twist drill—the tool most commonly used in Radials—is much more efficient than it was in its earlier days. To illustrate: 15-16 inch holes are now drilled in steel rails under a feed of .02 in. per revolution. For such work and for drilling in cast iron, as well as for either boring or reaming, the feeds on any Radial other than our own are utterly inadequate.

A striking example of the importance of providing the Machine with a wide range of feeds is shown by the loss incident to dropping down a single feed in drilling a ¾-in. hole in cast iron. The correct speed for this work is 171 revolutions per minute. If the drilling be done under a feed of .007 in. per revolution instead of .01 in.—the finest feed that should ever be employed in drilling a ¾-in. hole in either iron or steel—the spindle advances in ten hours through less than 60 ft. as compared to 85.5 ft. that it would pass through under the faster feed, thereby entailing a direct loss of exactly 30 per cent.

A HEART TO HEART TALK ON RADIAL DRILLS



THE NEW BICKFORD RADIAL.

The New Bickford Radial is equipped with speed and feed boxes which provide suitable speeds and feeds for ALL classes of work. Our Booklet

"56 POINTS OF VANTAGE"

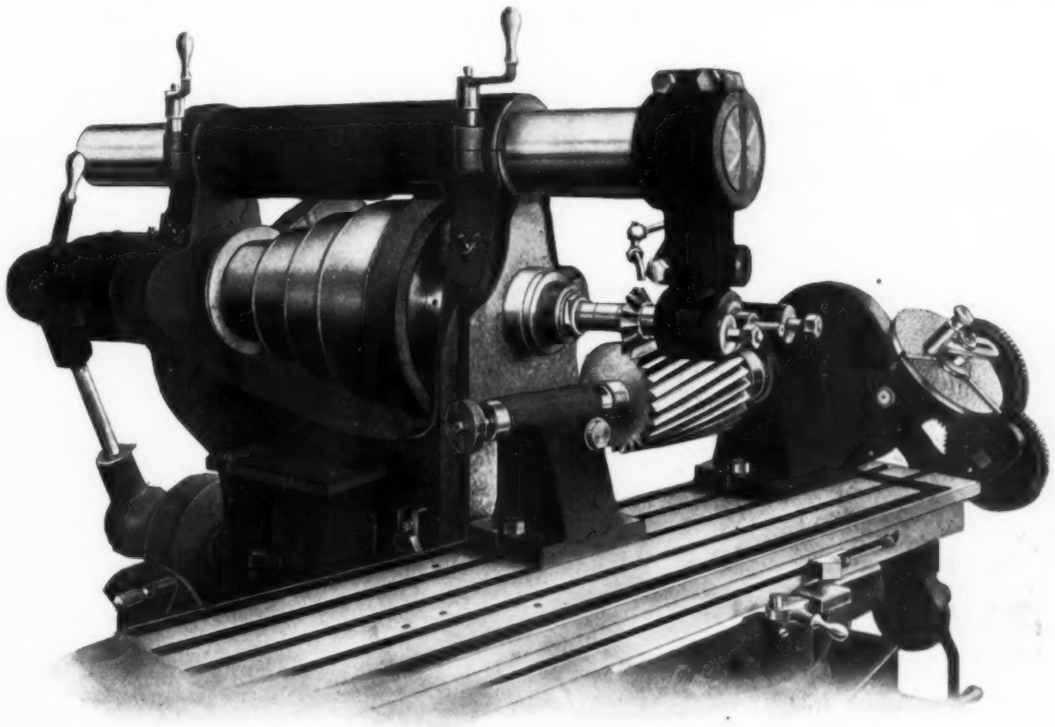
describes the Machine in detail and it's free for the asking.

The Bickford Drill & Tool Co.,

CINCINNATI, OHIO.

FOREIGN AGENTS—Schuchardt & Schutte, Berlin, Cologne, St. Petersburg, Stockholm, Vienna, Brussels and New York. Adphe. Janssens, Paris, France. Charles Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. F. W. Horne, Yokohama, Japan.

39 A



A New Record.

Here is a job of milling 24 teeth at a 14 degree angle in a tool steel blank 5½ in. diameter by 7½ in. long turned up from an unannealed bar. The grooves are ½ in. deep, ¾ in. wide at the top; the stock was removed at one cut at a table feed of ¾ in. per minute. They were finished at a table feed of 1 5-64 in. per minute. This beats all records even over larger machines of other makes used by one of the best known cutter makers in the world and resulted in this statement: "We are very pleased to state that after a very thorough test, we are quite pleased with it, and should we order any more Universals we will favor you with the orders for machines exactly like this one."

Another cutter maker has bought two machines likewise equipped.

It's the strong, stiff "CINCINNATI MILLER" with Special Spiral Cutting Head and geared feed that did it. Do you have any use for record making machines?

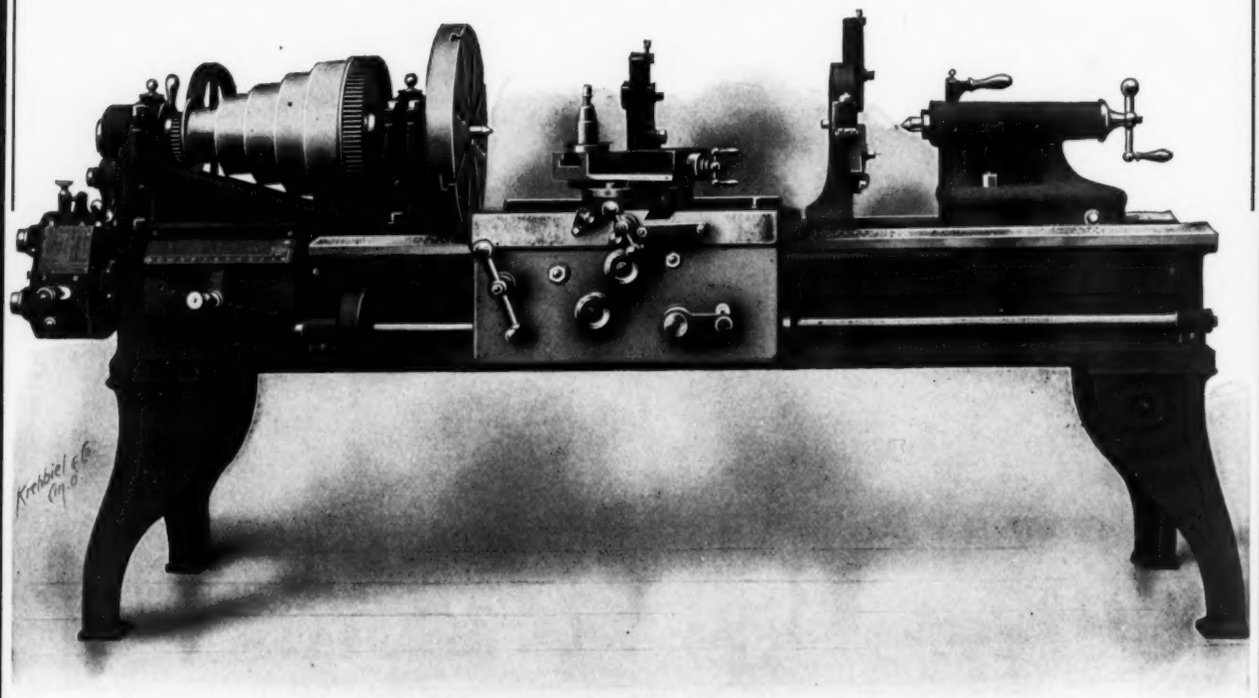
Ask for our pamphlet, showing examples of rapid milling.

The Cincinnati Milling Machine Company,

CINCINNATI, OHIO, U.S.A.

EUROPEAN AGENTS—Schuchardt & Schutte, Berlin, Cologne, Vienna, St. Petersburg, Brussels, Stockholm and New York. Adolphe Janssens, Paris. Chas. Churchill & Co., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. The Niles Tool Works Co., 23 Victoria St., London, S.W.

THE NEW "AMERICAN" 18-INCH LATHE.



Has a rapid change-gear mechanism through which a range of **forty-four changes** of **thread** is instantly and easily available, while the machine is in full operation and **without the removal of a single gear.**

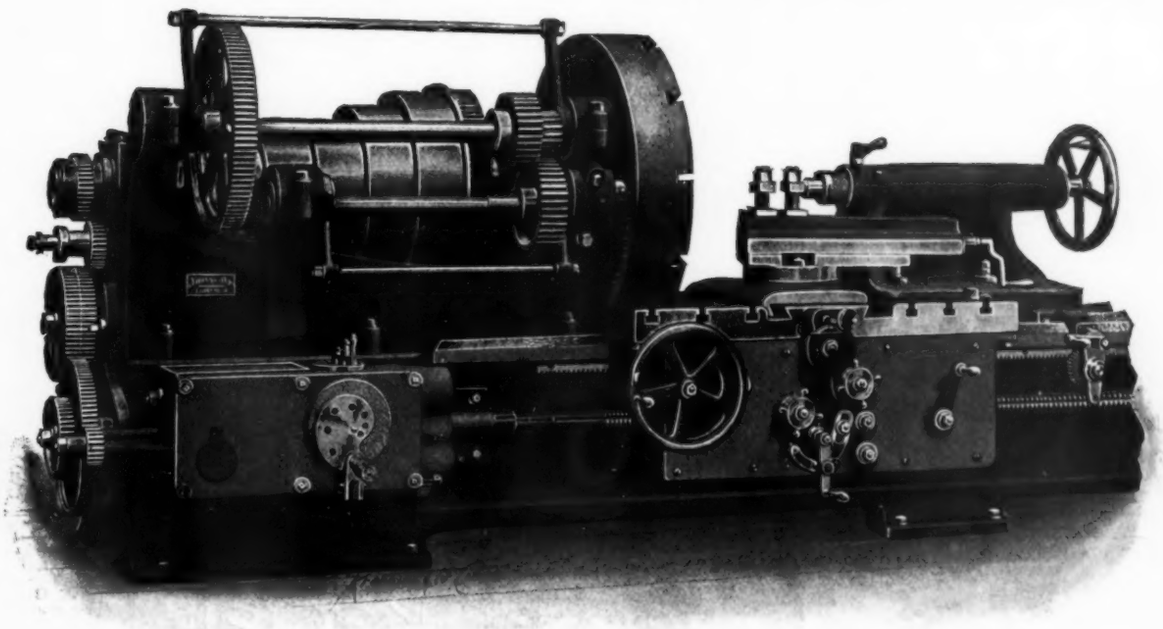
A lathe of exceptional productive capacity, with a strength and rigidity sufficient for the heavy strains induced by the increased cutting power of modern tool steels.

The **"American" Lathe Pamphlet** gives the full description. Also—

PLANERS, SHAPERS, DRILLS.

The American Tool Works Company, **Cincinnati, Ohio, U.S.A.**

New York Store: The Fairbanks Co., Elm and Broome Sts. Boston Store: 36 Federal St. Philadelphia: The Fairbanks Co. St. Louis Store: 720 N. Second St. Pittsburg Store: Empire Bldg. Detroit: C. C. Wormer Machinery Co. Minneapolis: The Northern Machinery Co. Chicago Store: O. L. Packard Mach'y Co., 34-36 S. Canal St. Milwaukee: O. L. Packard Mach'y Co. Birmingham: Milner & Kettig Co. San Francisco: Henshaw, Bulkley & Co. Toledo: National Supply Co. Cleveland: The Strong, Carlisle & Hammond Co. London: Alfred Herbert, Ltd., 7 Leonard St., Finsbury, E. C. Coventry: Alfred Herbert, Ltd. Berlin: De Fries & Co., Act. Ges., Kloster Strasse, 13-15. Dusseldorf: De Fries & Co., Act. Ges., Graf Adolph Strasse, 83-87. Paris: Roux Freres & Cie., 54 Boulevard du Temple. Vienna: De Fries & Co., Act. Ges., Eschenbachgasse, 9.



The Happiest Handling Of Heavy Work

comes thro' the use of the lathes of Schumacher & Boye, that have had deliberate painstaking design and building to this one solitary end.

These lathes are heavy lathes where weight counts to counteract possible strains; iron is used to a practical purpose and not to carry the impression of weight.

While S. & B. Lathes represent the extreme in lathe accuracy and convenience, this accuracy and convenience does not come thro' the use of dainty, easily broken attachments. Every part of an S. & B. Lathe is strong and sturdy, is built to resist things, built to last forever.

There is a certainty that work will be finished when it is put on an S. & B. Lathe, and this certainty might be a good thing for you to consider and keep in mind.

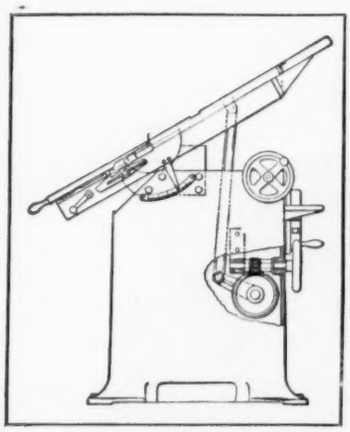
A few of the many features entering into our 36 in. and 42 in. lathes are: the double apron to prevent overhang, power angular feed of twelve inches to compound rest, the patented instantaneous change device for feeds and screw cutting, and a number of others described in our Book.

Schumacher & Boye

Engine Lathes

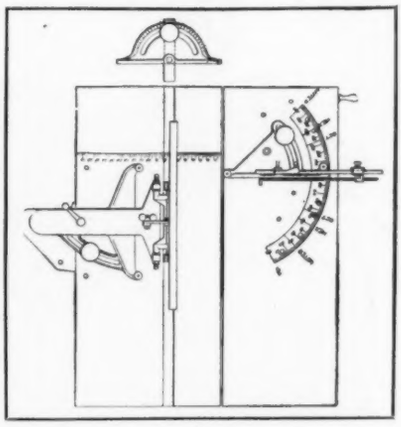
Cincinnati, Ohio, U.S.A.

Head Work and Hand Work Saved by Machine Work



when the Oliver Saw Bench is used in your pattern shop. The head work is saved by not having to figure those difficult compound angles. Just go by the dial and you'll be right, within three-thousandths of an inch. The hand work is saved by doing your sawing in a mere fraction of the usual time. Either cross-cut or rip saw is brought into action almost instantly, by the simple turning of a handle, and the machine doesn't have to stop for the change either.

Both these savings resolve into savings of time and money. We don't suppose you have any objection to reducing the cost of your pattern making; especially as the patterns will be more accurate. Our Saw Bench Circular describes the many good points that have made us many good friends.



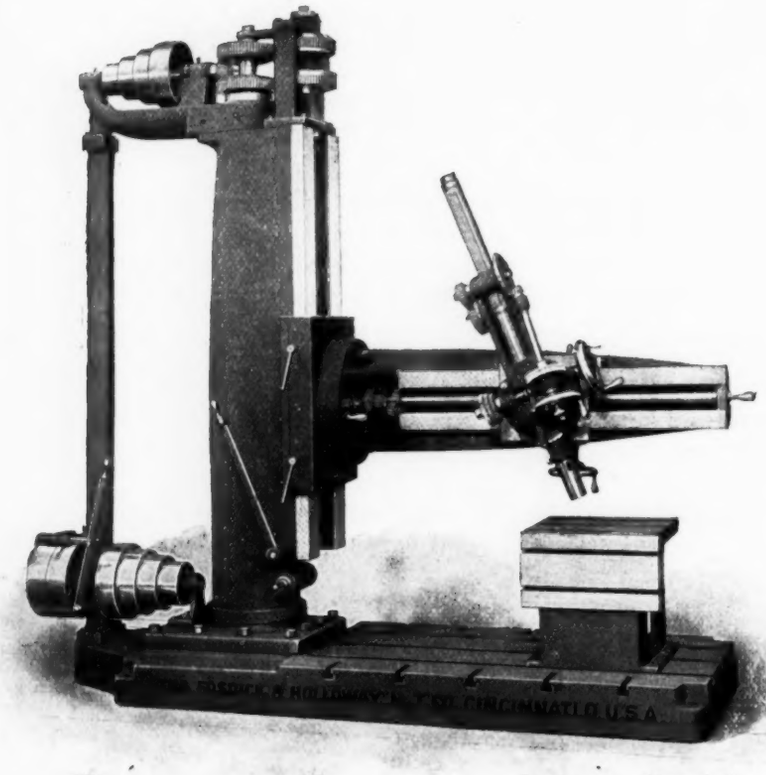
American Machinery Co.,

20-22 MILL ST., **Grand Rapids, Mich.**

Oliver Saw Benches, Hand Jointers, Band Saws, Wood Lathes and Complete Pattern Shop Equipment.

BRANCH OFFICES: 47 Grosvenor Chambers, Deansgate, Manchester, Eng. Also Fenwick Freres & Co., Agents, Paris, Brussels, Milan, Zurich and La Chaux de Fonds, Barcelona.

Five-Foot Universal Radial Drill



With Swiveling Head.

This Tool Has Many Desirable Features.

If you want a tool for *hard*, *accurate* and *rapid* work try one of ours.

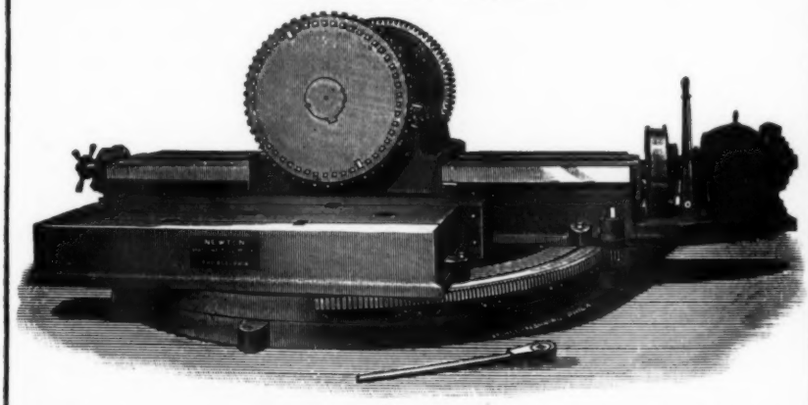
The Fosdick Machine Tool Co.,

Cincinnati, Ohio, U. S. A.

New York Office: 126 Liberty Street.

NEWTON

Cold Saw Cutting-Off Machines,
Milling Machines,
Slotting Machines,
Boring Machines,
Portable Electric
Driven Tools,
Locomotive Shop Equipment.

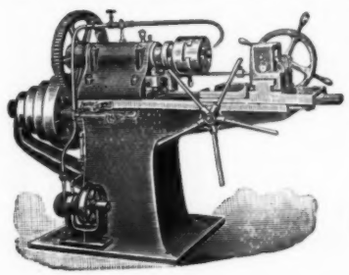


Rotary Planers, Built in 7 sizes, with 24″, 30″, 36″, 42″, 48″, 54″ and 60″ Heads.

Built on turntable or plain, either electric or belt driven.

Newton Machine Tool Works, Inc.
PHILADELPHIA, U. S. A.

The Dies in the Head of the Adams Bolt Threaders



have all the advantages of both open and solid dies without the disadvantages of either. Practically they are solid dies with the advantage of releasing bolt after threading, thereby preventing the stripping of threads by running back over them. All details in book.

Detrick & Harvey Mach. Co.
Baltimore, Md., U.S.A.

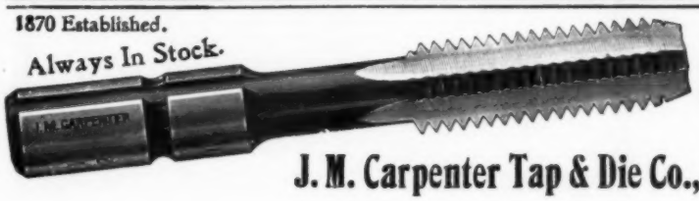
Get Card's Taps and Then You'll Be Sure.

What's the use of shopping and fussing around when you can get Taps from Card and get Taps you can depend upon.

S. W. CARD MFG. CO., - Mansfield, Mass., U.S.A.

Chas. Churchill & Co., London, Birmingham, Manchester and Glasgow.

1870 Established. Always In Stock. Incorporated 1891.



Trade C Mark.

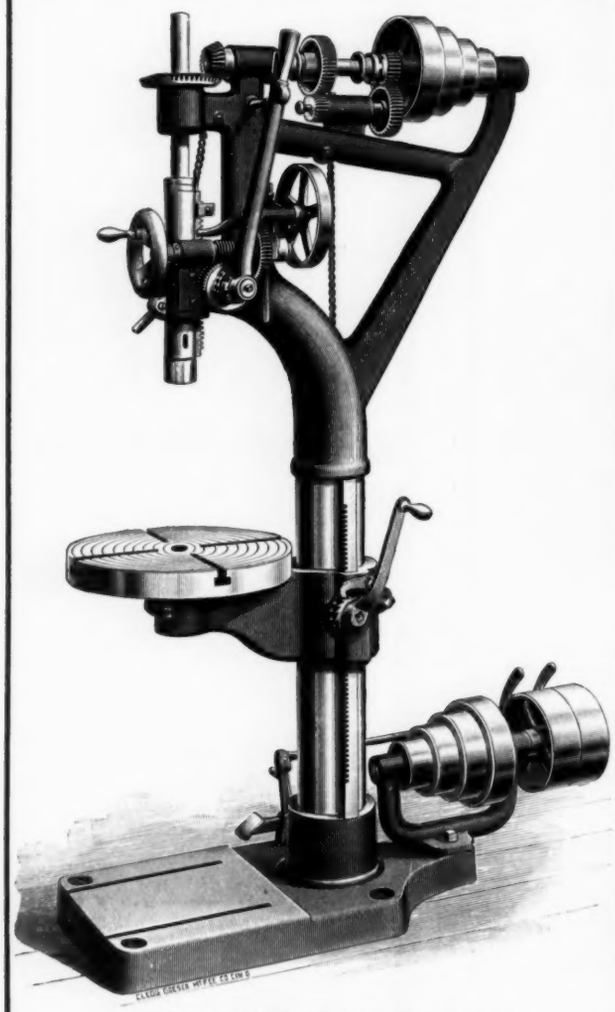
J. M. Carpenter Tap & Die Co., PAWTUCKET, R. I., U. S. A.

Vici Belt Is Oil Proof,

that is, it is not affected by oil. Oil makes oak belting soggy and causes it to stretch and run uneven, as well as shorten the life of the belt. No such effect has oil upon VICI belt. We cannot give all the good points on VICI BELT in this space, but if you will write us we feel we can satisfy you sufficiently to induce you to put in a trial belt or perhaps a roll.

Jewell Belting Co.
23 Trumbull Street,
HARTFORD, CONN.

174 Lake Street, Chicago.
262 W. Somerset St, Philadelphia.
Crane Co., San Francisco, Cal.,
Sales Agents for Pacific Coast.



DAVIS' 20-INCH DRILL—B. G. & P. F.

January 10, 1903

we will have fifty **20″ Drills,** with back gear and power feed, for shipment.

We guarantee these drills equal in accuracy and workmanship to any made.

For sale by representative dealers in all large cities.

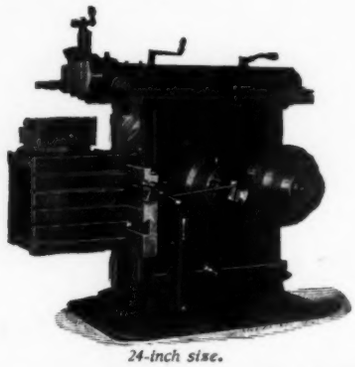
For further particulars, address

The W. P. Davis Machine Co.

ROCHESTER, N. Y., U.S.A.

"Entirely Satisfactory in Every Way"

Writes one of the users of our **UNIVERSAL SHAPING MACHINES,** who installed two machines about three years ago. During that long period they have still maintained their prestige, **STANDARD OF EFFICIENCY.** Circular tells all about their universal features. Sent free upon request.



24-inch size.

POTTER & JOHNSTON MACHINE CO.,

PAWTUCKET, R. I., U. S. A.

New York Office : 126 Liberty St. Walter H. Foster, Manager.

The Three Vital Points

in an

Automatic Turret Lathe

are

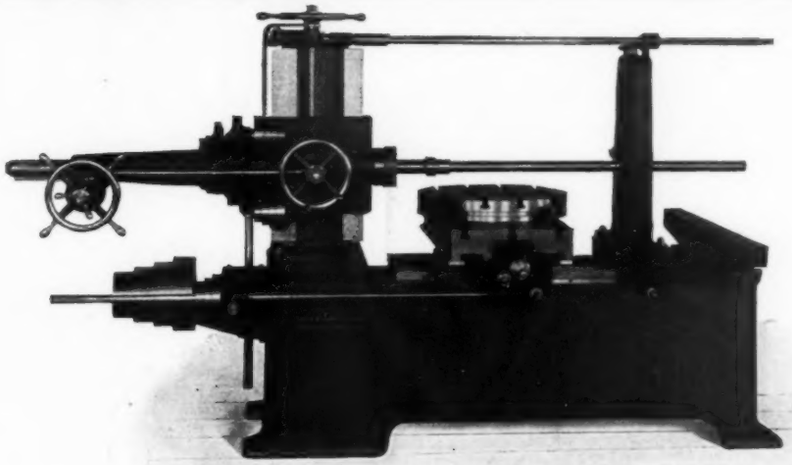
Accuracy, Adaptability, Amount of Output,

and in these none equal

The GRIDLEY.

Better than the others in other ways too.
Ask us about it.

Windsor Machine Company,
Windsor, Vermont, U.S.A.



On the famous

Built by Lucas Machine Tool Co.

"Precision" Boring, Drilling and Milling Machine

We absolutely guarantee permanent alignment. Other manufacturers will not guarantee perfect alignment even when their machine reaches its destination. Do you see the point? Buy a "Precision," if you want the best.

Hill, Clarke & Company,

Machinery Merchants,

14 So. Canal Street, Chicago. Main Office, 156 Oliver Street, Boston. 123 Liberty Street, New York.

Pittsburg Representative, Chas. G. Smith Co., 347 Fifth Avenue.

The Particularly Pleasing Features of Landis Grinders

are accuracy, convenience and rapidity of production, all having as a final result an increased distribution of dividends among your stockholders.

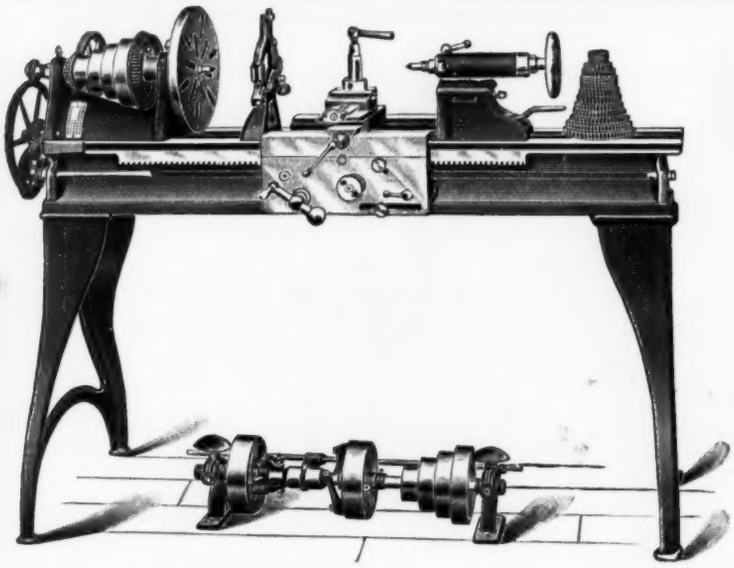
This is No. 1 Universal; capacity is 10-in. swing, 20-in. between centers. Emery wheel is 10-in. diameter, $\frac{5}{16}$-in. to $\frac{5}{8}$-in. thick, 4¾-in. hole, and has five changes of speed, from 1529 to 3301 R. P. M. Work has twelve changes, from 40 to 624 R. P. M.

These Grinders—they are made in sundry styles and sizes, covering all grinder requirements—are for the finishing of much work heretofore handled on a lathe with more or less success. Aside from a more accurate production of work is the feature of time saving. This saving amounts to perhaps 25% to 60%, depending upon the nature of work. Landis Grinders are proven and tested. They have passed the trial of years and stand in a class by themselves—the first class, the Landis class. Treatise on grinding on request.

Landis Tool Company,

Waynesboro, Pa., U. S. A.

Walter H. Foster, Manager, New York and Boston. Hill, Clarke & Co., Chicago. Brown & Zortman Machinery Co., Pittsburg. Marshall & Huschart Machinery Co., Cleveland and Cincinnati. C. W. Burton, Griffiths & Co., London. Ad. Janssens, Paris. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm and St. Petersburg.



No. 13 LATHE

13 inch Swing.

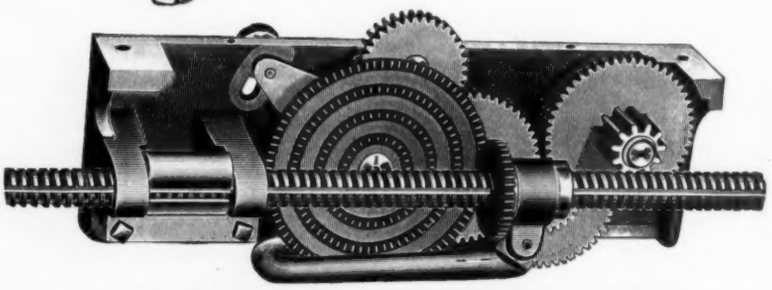
Look at the positive feed in the carriage; consider the variety of feeds without change of gears; a strong feed and not equaled by any lathe of its size; has compound rest and automatic cross feed; has hollow spindle and set-over tail stock; is back geared and cuts right or left-hand screws. Every gear is cut from solid metal; the best of workmanship, accurate and practical, strong and convenient in operating.

PRICES:

With Countershaft, 5 ft. Bed	$157.00
6 " "	167.00
7 " "	177.00
8 " "	187.00
10 " "	207.00

With Foot Power $5.00 less.

DISCOUNTS ON APPLICATION.

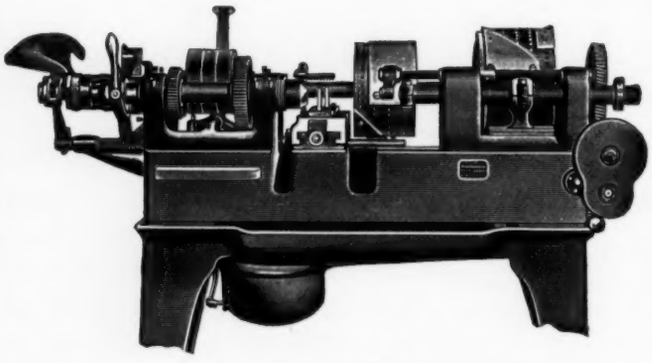


Feed Arrangement in Tool Carriage. Pat. May 6, 1902.

SOLE MANUFACTURERS,

W. F. & JNO. BARNES CO., 1995 Ruby St., (Established 1872) Rockford, Ill.

Cleveland Automatic Machines



Are unexcelled for forming and threading multiple parts from rod, bar or castings.

If you are making multiple parts from rods of steel, brass, copper, aluminum, okonite, bars of iron, brass or odd shaped castings, an investigation of the possibilities of Cleveland Automatics will convince you of their efficiency.

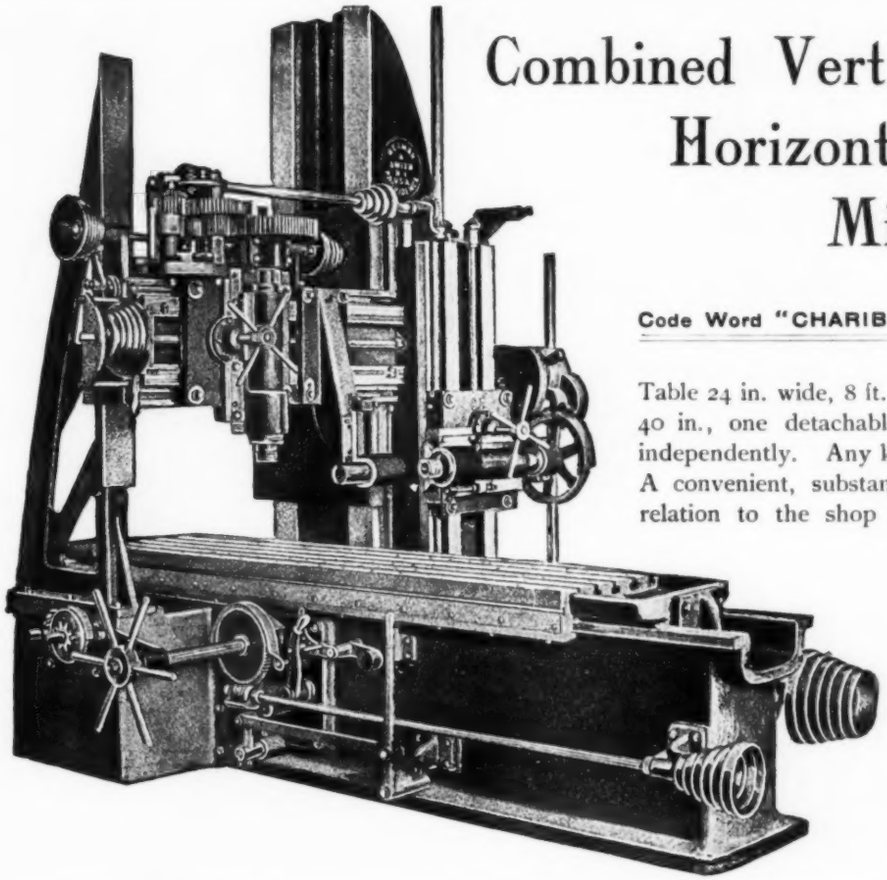
They are rapid, durable and entirely automatic.

One man can attend a number of machines. Write us for full information and catalog, or submit samples for estimate of output.

The Cleveland Automatic Machine Co.

Cleveland, Ohio, U.S.A.

FOREIGN BRANCHES: { Messrs. Chas. Churchill & Co., London, Manchester, Birmingham, Newcastle-on-Tyne and Glasgow. Messrs. Schuchardt & Schutte, Berlin, Vienna, Brussels, Cologne, St. Petersburg and Stockholm



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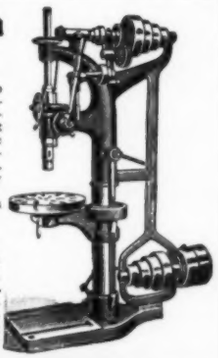

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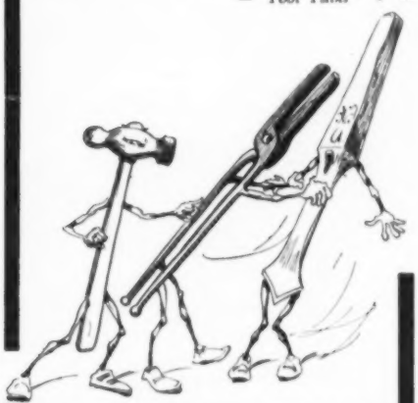

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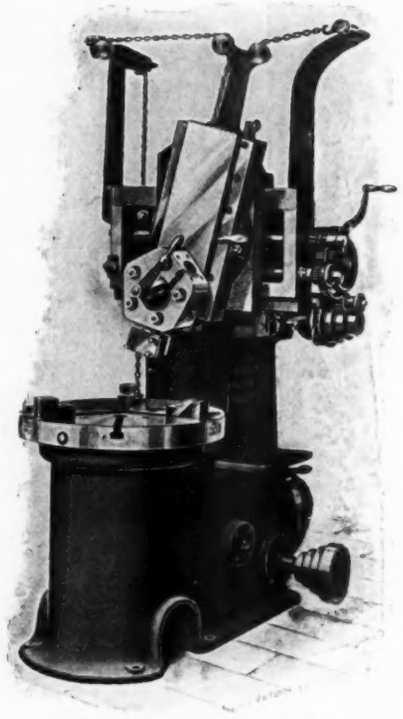

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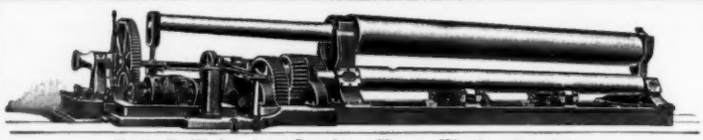

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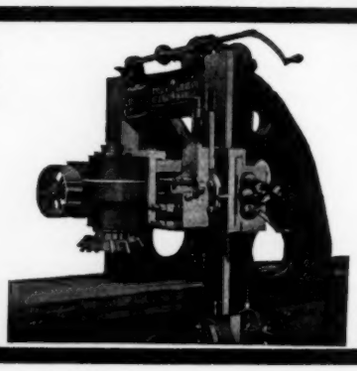

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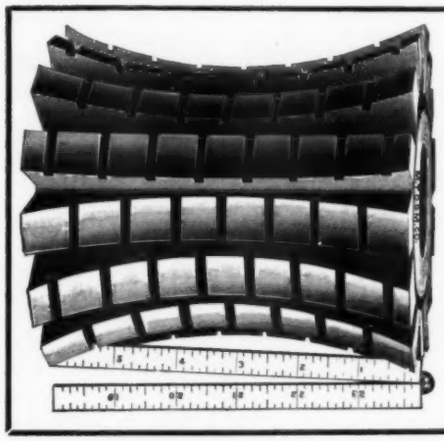

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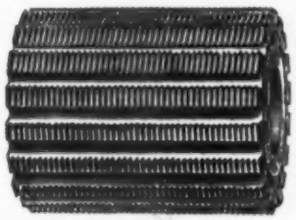

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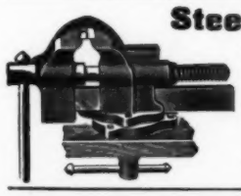

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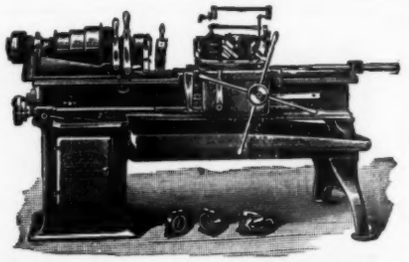

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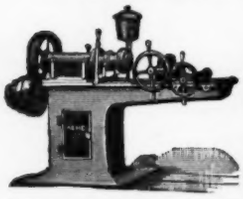

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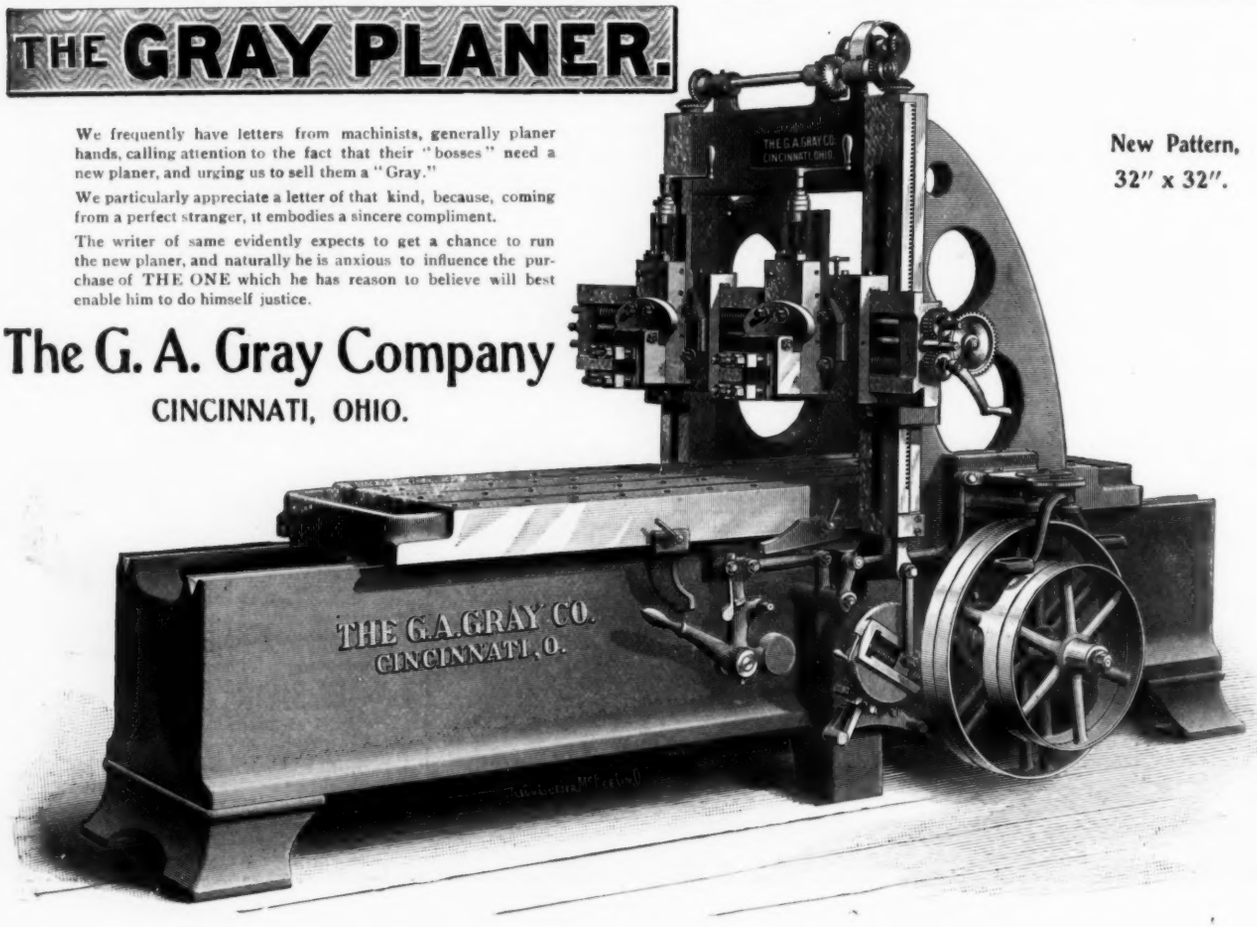
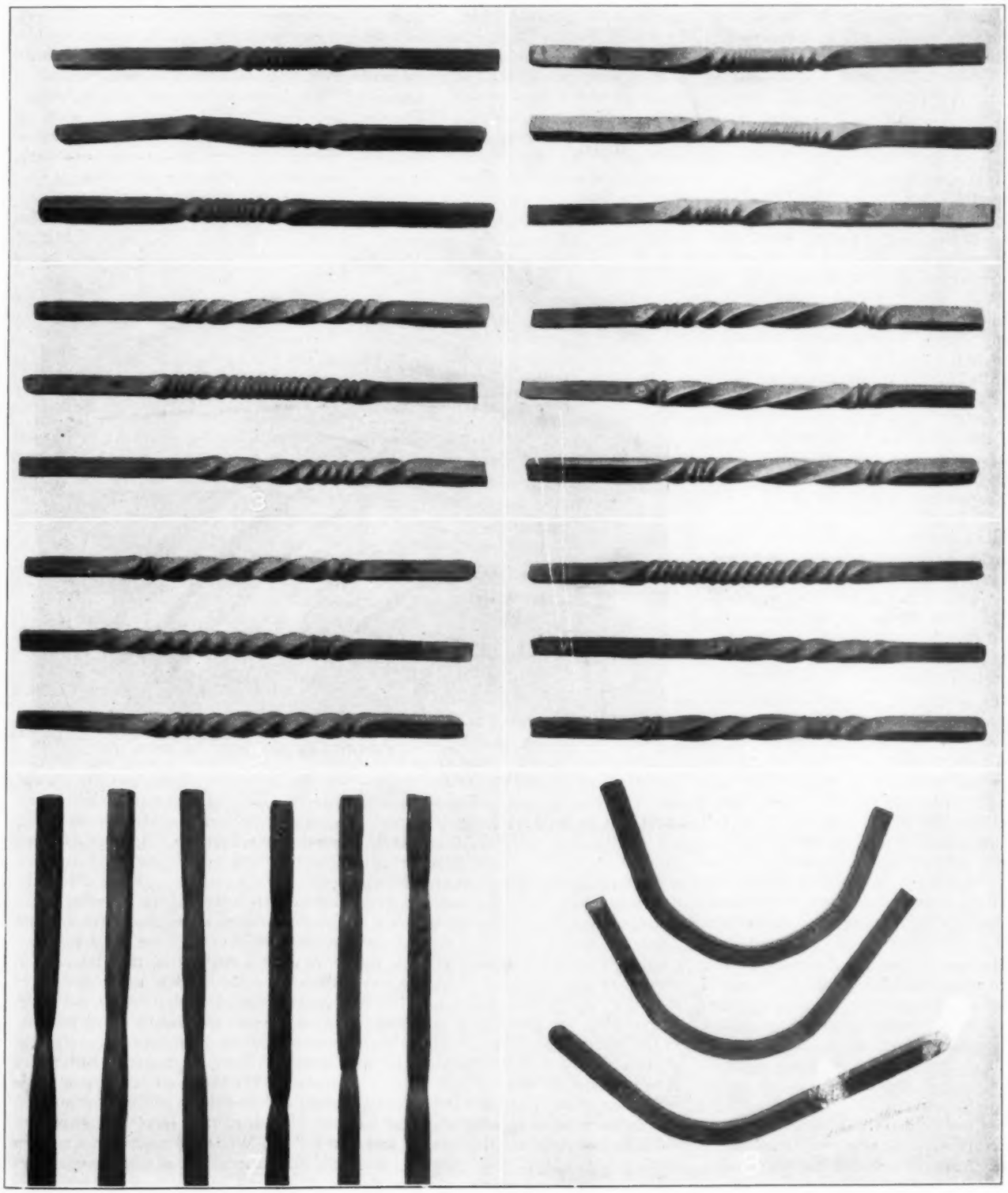


The Action of Iron and Steel Under Different Degrees of Heat.

BY J. J. WILMORE.

Some years ago the attention of the writer was called to some ornamental forgings that were being made by students in the blacksmith shop of the Alabama Polytechnic Institute. The design included some pieces of ½-inch square iron which were to be twisted, and the students were having difficulty in getting a uniform pitch to the twist. The iron would be heated for several inches, clamped in a vise and twisted with a pair of tongs. As would naturally occur, the piece of iron was clamped in the vise and grasped by the tongs near the ends of the hot part where the heat merged from red to black. In almost every case, when the twist would be made, it would appear greater at the ends near the vise and tongs.

The first conclusion was that the fastenings must exert some influence to produce the effect. A piece was tried with the fastenings attached directly to the bright parts. In this case the twist came out very uniform. A long piece was then heated in the middle and clamped at the ends where the iron was cold. On making the twist the same effect was observed as at first, the greater twist occurred in the dark-red heat. Samples of ½-inch round iron were then tried to see if the form



THE ACTION OF DIFFERENT BRANDS OF IRON AND STEEL UNDER DIFFERENT DEGREES OF HEAT.

of cross-section had any influence. So far as could be observed, the effect was the same as with the square iron. The forge in which the specimens were heated was thoroughly cleaned and a fresh fire built with the good, clean blacksmith coal, samples of which were analyzed in the Chemical Laboratory and shown to be very low in sulphur and phosphorus. The results were the same as before.

Finally, two students—Messrs. J. S. Black and M. F. Kahn—took up the investigation as a subject for thesis work, spending a good deal of time and obtaining the following results. The work, while not exhaustive, covered a good deal of ground and was carefully done. The results are interesting if they establish, as the writer believes they do, that wrought iron is stronger when at a white heat than when at a red heat.

Careful search was made through the literature available, but only one reference was found alluding to similar observations. This was in the AMERICAN MACHINIST of November 11, 1897, in an article by Mr. B. F. Spaulding. He says: "There is a peculiarity about some iron which I have often observed with curiosity, but which I do not remember to have seen mentioned. If a bar of this iron is heated for some distance in the length of it to a uniform white heat, it appears to be stiffer in that portion than it is at the lower temperature, the red-hot part, which intervenes between the cold ends and the white hot part. This peculiarity of being less readily bent where it is the hottest is shown when an attempt is made to bend it by letting the middle rest against something, as, for instance, the horn of the anvil, while each end is pressed in a direction to bend the bar. The bar will then have a greater bend at the places where it is red than along the part where it is white."

The inference from reading this article is that Mr. Spaulding only attributed this property to certain kinds of iron, or to iron under certain conditions, but our experiments seemed to show that all wrought irons are similarly affected. The material for these experiments consisted of the following stock, all ½ inch square and ordered from a jobbing house: Jessop tool steel, a medium grade of American tool steel, machinery steel, Norway iron, charcoal iron, and common or stone coal iron.

The forge for heating the specimens was fixed with firebrick to limit the length of heat on each specimen and also to insure a uniform length for all. Special care was taken to keep the fire clean and in good condition. A good grade of blacksmith coal was used. The apparatus for twisting consisted of a lathe fitted with a vise and an extra spindle with a square socket in one end and a crank fitted on the other. After the specimen had been heated, one end was put in the socket and the other end fastened in the vise in line with the spindle. A few turns on the crank would do the work.

A small testing machine was used for making the tension tests. After a little practice the boys were able to put the specimen in the clamps and pull it out to breaking before any marked change of color due to cooling could be observed. No effort was made to measure the pull exerted by the machine.

For the bending tests, a sliding block operated by a lever was made to press on one end, the other end being supported by a fixed block. The specimens for this test had the ends made hemispherical.

In another test a small hammer head was fitted with a punch ground to an angle of 60 degrees and attached to a long handle pivoted at the end. Arrangements were made to fix the distance through which the hammer was allowed to drop. The specimen was heated, as in the other tests, laid on the anvil under the punch and the latter raised and dropped rapidly as the specimen was moved along, making the marks about half an inch apart.

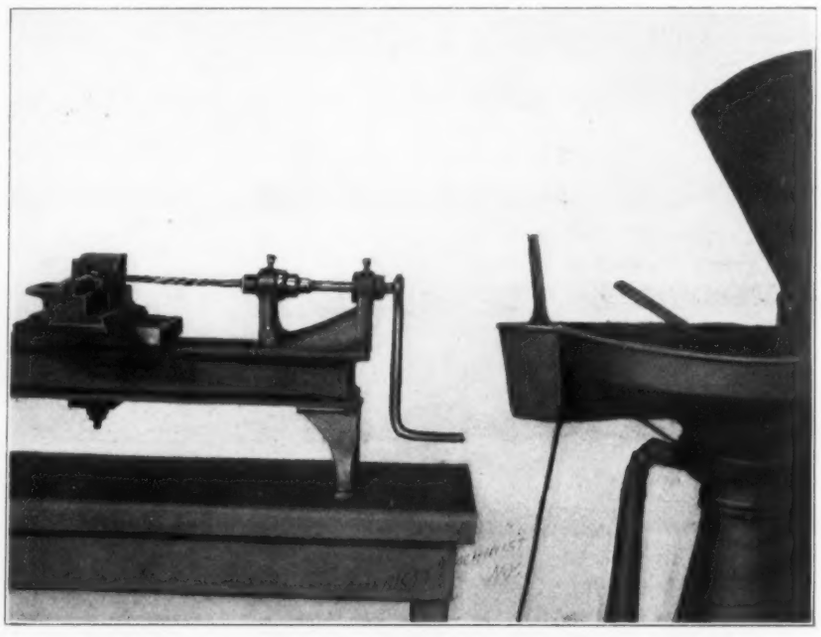


FIG. 9. APPARATUS EMPLOYED IN THE TWISTING TESTS.

The specimens were cut from the bar and were made of convenient length for the different tests. For the twisting tests they were about 12 inches long and three pieces of each kind of metal were tried. The illustrations show the results very clearly. The high carbon steel show the greatest twist at the point of highest temperature. The machinery steel gave indefinite results. One specimen seemed weaker in the hottest part, another twisted most at the red heat, and the third seemed to have two or three weak points.

The specimens of wrought iron gave unmistakable evidence of being weaker at the red heat, and the purer the iron the more marked the effect. The Norway iron seemed to twist all at one place in the dark-red heat, the part at the white heat showing very little twist. The charcoal and common irons showed less difference in strength between the two temperatures, though the difference is still very evident.

The tension specimens showed similar, but if possible more uniform results. The high carbon steels show the reduced cross-section at the point of highest temperature, while the machinery steel and the different grades of iron have the points of reduced cross-section, one on each side of the white-hot part. A number of these specimens pulled apart with very much less reduction of area than the material would have shown if tested in the ordinary way and at the usual temperature.

The bending tests were very inconclusive. Sometimes the bend would occur at the white-hot part and sometimes in one of the red parts, but never in a way to give definite information, either to corroborate or contradict that obtained from the preceding tests. The specimens shown in the illustration were bent with tongs over the horn of an anvil in the manner suggested by Mr. Spaulding in the article previously referred to. The punching tests could be seen by the eye to corroborate the twisting and tension tests, but the marks were too small to show in photograph and were unsatisfactory to measure for tabulation.

A careful analysis of the coal used in these tests showed less than one-half of one per cent. of sulphur. Care was taken to keep the fire clean and a sufficient thickness of bed was carried to insure that the metal would not be struck by currents of cool air. The bars were heated just to the point of sparking in the middle, and the total length of the heated part was about 6 inches. While the specimens shown in the illustrations were all made in one series of tests, yet these results have been duplicated many times before and since these

tests were made, taking iron from different lots and coal from other places. If these results are due to impurities in the fuel, it would seem that the tool steel would be more affected than the iron, as it is considered more susceptible to injury from such causes. But one of the Jessop steel specimens was twisted more than twenty revolutions without breaking, showing it was in pretty fair condition. Then we use the same fuel for tempering taps, dies, reamers and milling cutters, and they stand up to the work as well as any we can buy.

If this peculiar effect is due to some molecular action in the metal, it would be interesting to know what this action is and what causes it. It seems from the foregoing tests that a small amount of carbon will reduce the effect and that a larger amount will entirely eliminate it and cause the molecules at the highest temperature to be most easily moved. The writer has desired to pursue the investigation of this subject further, but time has not permitted him to do so. He would appreciate an account of observations of similar phenomena made by others and also suggestions as to methods for further investigation.

The illustrations show the results of the experiments. In these

Fig. 1 represents three samples of Jessop steel. The middle one was twisted more than twenty revolutions and did not break.

Fig. 2 represents ordinary American tool steel.

Fig. 3 represents samples of machinery steel. One seemed to twist most in the hottest part, one most in the coolest parts, and the third or middle specimen twisted very irregularly.

Fig. 4 represents samples of a good grade of charcoal iron. It will be noted that two of these broke off at the dark-red part of the heat.

Fig. 5 represents specimens of common or stone coal iron. Two of these are fractured, but not entirely broken off in the dark-red part of the heat.

Fig. 6 represents specimens of Norway iron. These were the first specimens tried and there was a slight irregularity in the length of heated part. Also one of the specimens cooled down to a red heat before being twisted, and it shows a very uniform pitch.

Fig. 7 represents the results of the tension tests. Beginning at the left there is Jessop steel, American tool steel, machinery steel, charcoal iron, common iron, and Norway iron. The machinery steel in all the tension tests showed the same characteristics as the wrought iron.

Fig. 8 represents two samples of wrought iron and one of machinery steel. These were bent over the horn of an anvil with tongs. The machinery steel in this case fails to show the characteristics referred to under Fig. 7.

Fig. 9 shows the apparatus for making the twisting tests.

Alabama Polytechnic Institute.

Motor Driving of Machine Tools.*

BY CHARLES DAY.

I have been very much interested in the papers of the evening, which have described in such detail the various systems of obtaining variable speed by means of the direct-current motor, but I have not as yet heard a satisfactory answer to the question asked by you when opening this discussion, a question of utmost importance to all manufacturers contemplating improvements or extensions to their machine shops: "Does it pay to put individual motors on machine tools? and if so, does it pay to go to the additional expense of obtaining variable speed?"

Over seven years ago, Mr. Horace L. Arnold wrote a splendid article on this subject, entitled "Production to the Power Limit," stating in the most forcible manner the principles underlying economic production. It seems to me that anyone who is contemplating the advisability of driving machine tools with individual motors could not do better than read this short article and then endeavor to follow up this line of thought by making a most thorough study of the requirements of each particular machine.

During the past three years few subjects have received more attention in the technical papers and engineering organizations than the use of the motor as a means of driving machine tools, but so far the discussions have usually dealt with details of motor design and operation, or the advantages derived from electrical driving only considered in the most general way. It is time that we consider this subject from a broader standpoint, giving the motor the position that it rightly holds but not losing sight of other factors, the developments of which are essential to the efficient operation of the scheme.

If a machine shop is to be run in the same way after the introduction of a costly system of motor driving as before such an expenditure, interest and depreciation will not be made on the investment. On the other hand, the shop superintendent who is thoroughly alive to the possibilities in machine-shop work may find in the motor a solution to certain details which make possible the highly efficient results he is aiming for.

Ease of handling and close speed regulation—the principal advantages claimed for the variable-speed motor—are terms that can only be used in a relative sense and the saving effected by bettering these conditions will only justify a certain expenditure, so the cost of different methods of arriving at the result should be most carefully considered.

One of the speakers said in the discussion that the problem of machine-tool operation had been turned over to the electrical engineer, the mechanical engineer failing to accomplish the desired result.

I feel that it is a great mistake to intimate that a field of as broad a character as the one we are discussing should be entirely in the hands of any one division of engineers, their combined efforts being necessary if the desired result is to be arrived at in the least time. There are no definite data that can be placed in the hands of the electrical engineer to form a basis for his work, but he must personally familiarize himself with every detail of shop equipment, methods and requirements before the need of certain improvements is felt with sufficient force to call forth his best efforts in design and construction. The impressions and convictions that one arrives at after earnest study of present conditions and possibilities in the machine shop, lose their force when repeated to another party, and the relative importance of all the details that make up the general scheme is lost entirely.

Such details as the total range in motor speeds, and the number of running points required, differ in each of the systems described this evening, and if we wish to decide which one to adopt we must know the character of the metal we are machining, the cuts we can remove and the speed made possible by the tool steel used and the facilities for driving the work. The means provided for determining the cutting speed is another important factor, as it is the ability to use the apparatus to its full efficiency under working conditions that determines its real value. I have seen over and over again controllers designed to give a speed regulation of 5 per cent. introduced into machine shops where the operators had no facilities for judging the correct cutting speed closer than 30 to 40 per cent., the advantages of the much-talked-of close speed regulation being entirely lost.

Mr. Blackwell stated that 4 to 1 was sufficient range in speed for efficiently machining *any given piece of work* and dwelt at some length on this particular case, showing charts of the savings effected by the use of a variable-speed motor. In shops doing a general line of work, it is very seldom that work turns up where the tool works from the outside to the center and this problem is never the deciding factor in the range required. Speed control is obtained in nearly every case by a combination of mechanical and electrical means, the motor range and gear ratios depending upon the machine and the average variation in diameters and kind of material handled.

When attaching motors to old tools, such as lathes and drill presses, we must —as far as possible—adapt our speed range to the present gear ratios; in some cases by introducing additional gears and in others, without change to the machine. We have found that the gear ratios vary

*Contribution to a discussion at the November 21 meeting of the American Institute of Electrical Engineers.

from 3 to 1 up to 15 to 1, depending on the size and character of the machine.

We have frequently endeavored, by careful figuring, to show just what saving would be effected by replacing the belt and step cone by a variable-speed multi-voltage system, assuming in each case that the equipment was driven to its full capabilities. Taking into account all the limitations arising from variations in material, and so on, we have found it hard to show by such comparison a saving greatly in excess of the interest and depreciation on the investment. It is, however, the indirect savings that make the motor of such value as a method of operating machine tools. The power limit on most of the standard machines is absurdly low when we consider the high cutting speed that the modern air hardening steels permit of. On large machines, such as boring and turning mills, doing general work it is impossible to have the machinist shift his belt as often as he should, as by so doing he would be physically worn out at the end of each day, or if such a condition can be arrived at, it would only last a short time, the workman soon relaxing his efforts until the old conditions exist again. The motor, with great ease of control, removes all these difficulties and but small incentive is necessary to assure the continued efficient operation of the plant.

You must ever bear in mind, while considering machine-tool driving, that it is inconsistent to spend all our energy to develop one detail while other equally important factors are ignored. The feed mechanism on a lathe, for example, is too often neglected, and so it is with many other details.

I want to call attention, before closing my remarks, to the erroneous impressions usually conveyed when citing as a characteristic example, the time saved on a given job. Such data have no real value unless we know just how long the tool runs under cut, the hours it is working each year, the wages of the operator and many other details that it is impossible to carry in one's head.

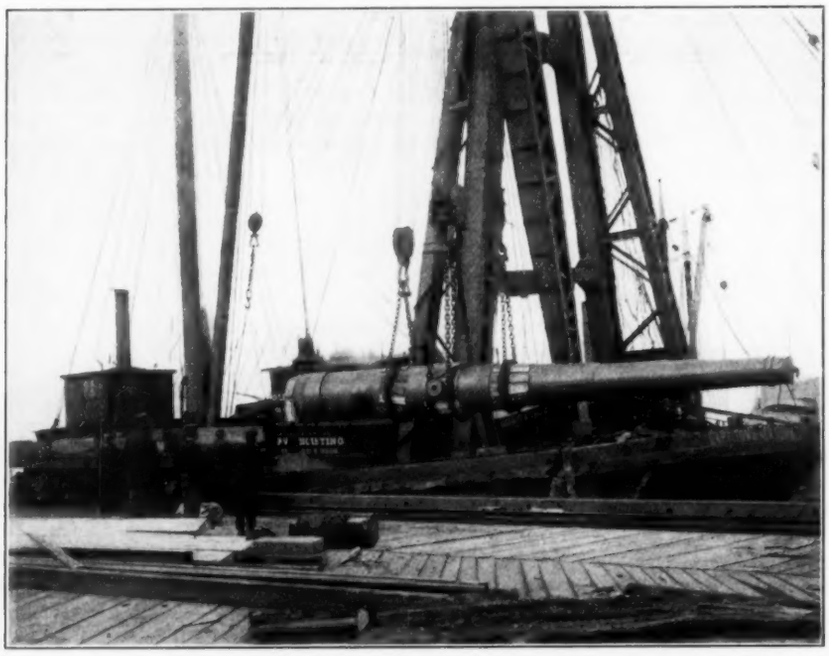


FIG. 1. THE 16-INCH RIFLE RAISED CLEAR OF THE FLOAT.

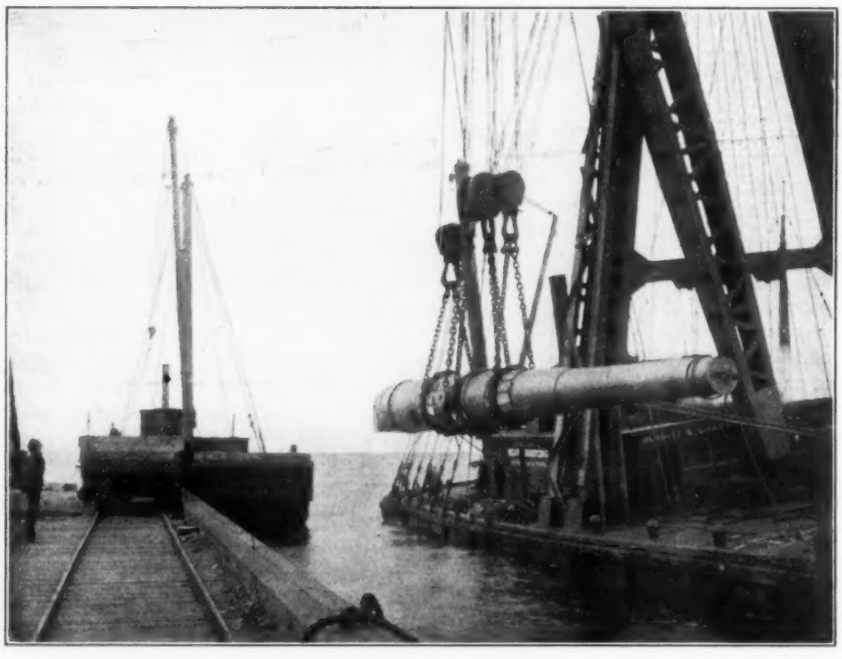


FIG. 2. THE FLOAT DRAWN OUT.

At the works of our clients, the Link-Belt Engineering Company, Nicetown, Pa., we have obtained data extending over four years, from which we can figure the pound price of their product. After taking into account every factor which might in any way affect the result and deducting 10 per cent. which was given the workmen in changing from a ten- to a nine-hour day, we can show a clear saving of 30 per cent. on the entire labor bill. This is due to better methods, tools and tool steel, and better methods of driving the machines, and the saving is largely in excess of the interest and depreciation on the entire expenditure necessary to effect it.

It seems to me that if shop managers, who, having installed the motor as a means of driving individual machines, would endeavor to get data of this kind, the advantages which can be derived from such an installation would be made evident and aid greatly in the general adoption of such systems.

The Big Gun at Sandy Hook.

We have previously noted the arrival at Sandy Hook of the big 16-inch rifle and our engravings show the gun as it was being transferred from the float (on which it came down the Hudson River) to the railway car at Erie Basin. At Fig. 1 the floating derrick of the Merritt & Chapman Company is seen lifting the gun from the float. Fig. 2 shows the gun lifted clear of the float and the float drawn out from under it, while Fig. 3 shows the derrick warped in towards the wharf and with the gun nearly ready to be lowered into position on the specially constructed car. As we previously stated, the transportation charges for this were $5,400, and the work was probably well worth it. The weight of the gun as shown is about 150 tons.

The *American Miller* has caught on to the fact that milling worms in a machine shop is not the same operation as milling worms in a flour mill.

Foreign Trade Notes.

GERMAN MACHINERY TRADE FOR THE HALF YEAR.

Statistics of the foreign machinery trade of the German Empire show imports of machinery and machinery parts amounting to 27,850 tons, as against 44,008 tons for the corresponding portion of 1901. Exports in the same lines were 101,235 tons, as against 104,069 tons for the first six months of last year. Machine tools show a great gain as regards exports, while the import figures are insignificant. There were brought into Germany in the first half of this year only 679 tons of machine tools and for the first half of last year 1,071 tons, while there were exported for the said portion of this year 8,266 tons, against 4,231 tons for the same part of last year.

WHAT IS A MACHINE TOOL?

The German Machine Tool Builders' Association has had this matter laid before it by the Imperial statistical authorities, the question being an important one in respect to classification of imports and exports. The committee which has passed upon the question holds that "a machine tool is a machine for mechanically working metal, wood or stone, with the purpose of giving it form according to a previously determined measure by employing one or more tools." This is what is commonly understood by the term in technical circles, but a certain specimen of classification submitted for the opinion of the society by the official bureau had given it a broader scope, extending to machines for working other materials, like leather and paper, as well as for working and reducing ores. The committee's classification has been formulated in divisions and subdivisions, the main heads of which are as follows—A. Metal working machines, including: I, Lathes; II, Planing machines; III, Shaping machines (the German word for these, "Stossmaschinen," is also applicable to slotters, keyseaters, etc.); IV, Drilling machines ("Bohrmaschinen"); V, Screw machines; VI, Milling machines; VII, Punching machines for rolling-mill products; VIII, Shears for rolling-mill products; IX, Band saws; X, Circular saws; XI, Bending machines; XII, Straightening machines; XIII, Presses; XIV, Riveting machines; XV, Hammers; XVI, Grinding machines. B. Stone-working machinery. C. Wood-working machinery. Boring and turning mills, boring machines, etc., for metal, come in Class I, or perhaps in some cases Class IV.

PRIZES FOR SUGGESTED INDUSTRIES.

The Sociedad Espanola de Minas, calle de Cardoqui, 11, Bilbao, Spain, has offered prizes in an international competition to suggest new industries suitable to be established in Viscaya. They should be something not yet introduced in the province, and pertain to the manufacture of iron or steel; to auxiliary industries, such as the utilization of coal by-products, slag, rolling-mill waste or furnace gases, or to the manufacture of refractory products from native or foreign earth; or to other lines of manufacture likely to prosper in the region and using as combustible either coal or electrical energy derived from water power in Viscaya or neighboring provinces. Full commercial data in regard to the proposed industries are desired. The communication should be made in Spanish or French. There are offered prizes of 12,500, 6,000 and 4,000 pesetas, also some five auxiliary prizes of 1,000 pesetas. They will only be awarded if the suggestions are deemed worthy. The competition will remain open until October 31 at least, and, we understand, until the middle of December, so there is probably time for would-be contestants to obtain full particulars.

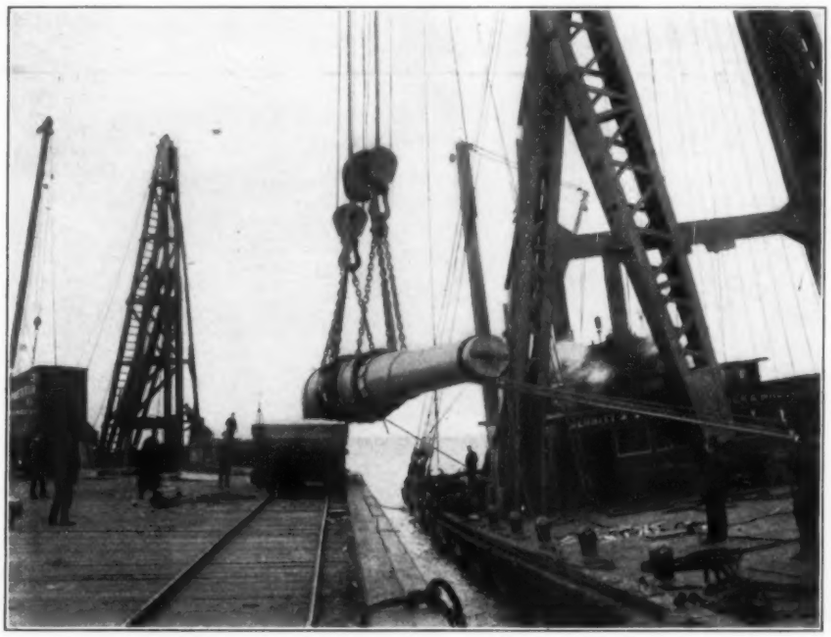


FIG. 3. ABOUT TO BE PLACED ON THE CAR.

MACHINERY TRADE OF ASTURIAS.

The English vice-consul at Gijon, Spain, gives the following machinery import statistics for the province of Asturias:

	1899.	1900.	1901.
England.....	£38,868	£73,312	£65,757
Belgium.....	122,172	87,928	52,620
France.....	7,389	6,206	26,900
Germany.....	4,585	47,560	66,563
United States.	246	6,148	12,750
Total.....	173,260	221,154	224,590

It is evident that France has largely increased her sales. The fact that the figures for England are not better than they are is to be attributed to high prices and long deliveries. An example of trade competition between France and England some time ago occurred where an 80-ton crane or shear leg was required at a certain seaport. The English houses demanded nine months to deliver it while a French one offered to do so in six and secured the order. This industrial condition of the two countries may help to explain the relative progress of France in the Spanish market, though we are inclined to think that Great Britain is now offering better terms in respect to price and delivery than she did. Germany now has a slight lead in the machinery trade, and herewith it may be noted that some figures recently given out by the German Machine Tool Builders' Association show that Germany is now sending a greater tonnage of machine tools to Spain than the United States is shipping to Germany.

In the province of Asturias there is said to be a very good demand for improved agricultural machinery, while coal mining is looking up so that there may be a favorable opportunity for mining machinery.

Some further information about the Spanish market is contained in a recent German Export Bureau report published by the *Deutsche Metall-Industrie-Zeitung*. According to this, Spain does not possess much in the way of a machinery industry, the numerous machine shops serving chiefly for repairs of the machinery imported from abroad by the many textile mills. The machine equipments of the cotton factories are valued at 408,000,000 pesetas. It is true that looms are made in Spain in great quantities, but they are very primitive as compared with the foreign-built ones. The importation of these articles would be still greater than it is if the high duty of 18½ pesetas per 100 kilograms did not stand in the way. Spinning machines come almost exclusively from Germany and England, though to some extent from Belgium, the last-named country furnishing especially those ma-

chines used for the preliminary work in spinning. Spain, where so many industries are now in a state of development, will long serve as a profitable market for foreign machinery. Machine tools, such as planers, shapers and others, are imported in great quantities most extensively from Germany, whose predominance in respect to price as well as quality, appears undeniable [?]. In the second rank for volume of this line of trade stand the United States, England, France and Belgium, while a lesser quantity is secured by Italy. The Spanish import figures for this class of manufactures amount to about $1,000,000 a year.

GOVERNMENTAL AID FOR JAPANESE STEEL WORKS.

It has looked as if the new steel works in Japan were going to prove a fiasco because of the neglect of the government to afford them the support which was anticipated, but it appears that appropriations have been made for them this year, whether to be regarded as adequate or otherwise. The lower house, in the form of a supplement for the year 1901-02, appropriated 1,054,000 yen for the public steel works at Yatamura. Of this sum 247,000 yen are to pay for materials already imported from abroad, and 514,000 yen to pay for materials already ordered. These steel works, from which profits were expected before this, are backward about filling anticipations. A sum of 6,340,093 yen has been allowed by the Japanese Parliament for the steel and armor plate works that were established quite a while ago in the war port of Kure, not far from Hiroshima. We understand that the disbursement of this sum is to extend over several years and that the expectation is to obtain considerable equipment in England.

MACHINERY DEMAND IN PERU.

A report on the Peruvian requirements for agricultural and manufacturing machinery and implements is now current in Germany. Such wares, aside from the rude implements made by native blacksmiths, come mostly from abroad. The appliances necessary for operating plantations of sugar, rice, cotton, maize and beans are imported. So is sugar-grinding machinery. Steam engines and boilers come from the United States, England, France and Germany. The larger engines (over 25 horse-power) are mostly English, while the smaller come chiefly from the United States. A German firm is interested in the introduction of electrical machinery, but the initial demand is very slight. Pumping machines of all sorts come from England and the United States. From the latter country come in largest share the threshing and corn-meal machines, as do also mowers and harvesters. Among plows, steam plows are mostly English, and the remainder chiefly from the United States. The imports of sugar-grinding and distilling apparatus are divided between different English firms, a French, a German and an American. Portable field railways with cars are delivered by a French firm, while small cars for sugar plantations are also furnished by English, American and German houses. The imports of sawing machinery, etc., yet unimportant, are a perquisite of various American and German firms. The United States meets the demand for machinery lubricating oil. The foreign firms have their arrangements well made so that orders can be quickly filled. In Lima there is a permanent industrial and machinery exhibition, in connection with which there have been certain remissions of such duties as were otherwise in force, yet the show seems not to have secured a great deal of patronage from foreign firms.

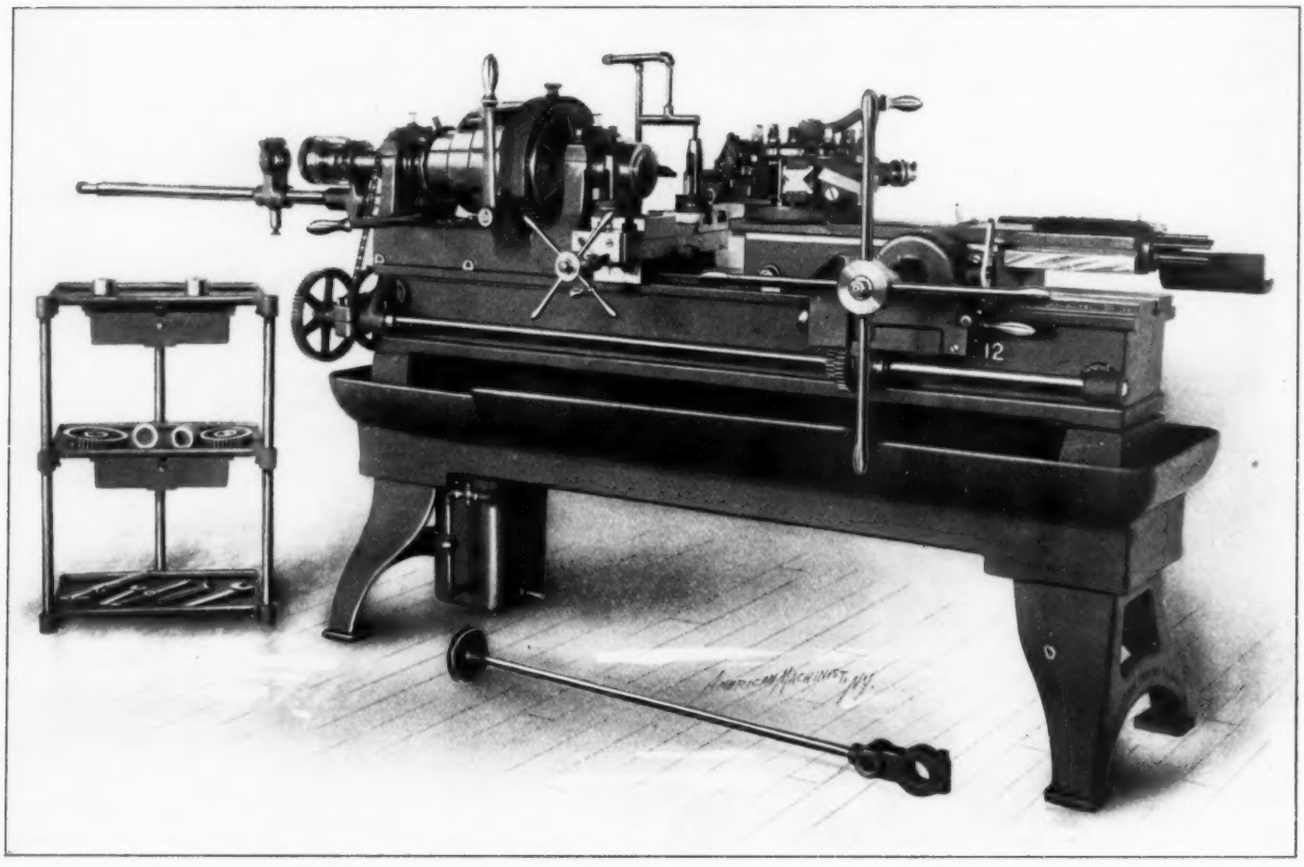


FIG. I. SCREW MACHINE.

MACHINERY STANDARDIZATION IN ENGLAND.

The London *Times* has devoted a long article to an interview of Mr. A. J. Balfour with a committee of mechanical and marine engineers who desire to bring about a standardization in motive power machinery and machine tools. It is argued that sometimes an establishment situated a long distance from where certain machines are built declines to buy them because it fears the cost of repairs. The *Times* remarks that the repair of special machines has cost amounts of money, time and labor little guessed by the general

public. Such a standardization as is advocated would bear analogy to the uniformity of rolling stock on American railways. It would have a notable advantage in permitting manufacturers to lay up stock in dull times. In this respect the United States now enjoys an advantage. What has especially aroused the British to the necessity of doing something to retrieve their mechanical fortunes is the large orders for railway material that have come to the United States from India.

2 x 12-inch Screw Machine.

The accompanying illustrations show a machine which is called by the builders their "universal screw machine," it being designed for handling long pieces, as well as for turning out regular screw-machine work, and its equipment of tools being

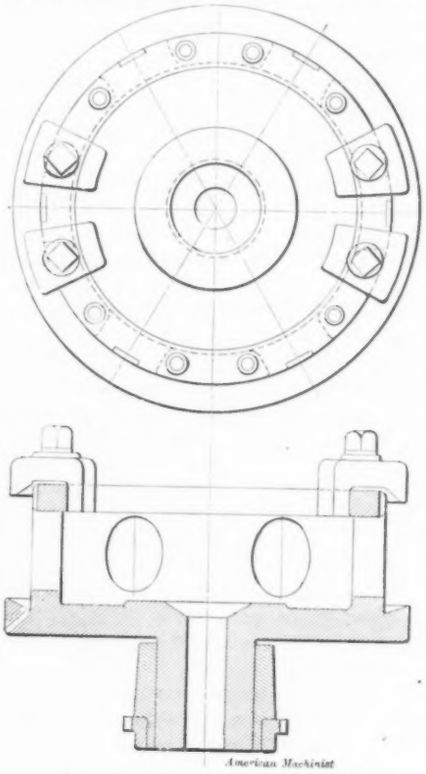


FIG. 2. SCREW MACHINE TURRET.

applicable to all classes of work requiring such operations as turning, threading, etc.

This machine will handle bars up to 2 inches diameter with wire feed, or 2⅜ inches without wire feed, and turn any length up to 12 inches. The bed, as will be seen by reference to the half-tone, Fig. 1, which gives an excellent idea of the general appearance of the machine, is quite heavy, and it is closed at the bottom, thus forming a box construction of great stiffness. It is mounted on a swivel joint, at one end, to avoid distortion, and placed in a large oil pan with oil reservoir fitted with pump and piping. Running the full length of the bed is a T-slot in which the headstock, cross slide and turret base are bolted.

The spindle bearings are fitted in bronze cap boxes. The machine is geared 6½ to 1, and driven by a cone pulley, a friction clutch being provided for changing instantly from cone to slow-gear speed while running. The largest step on the cone is 12 inches diameter and the driving belt is 3½ inches wide. The spindle has a large nose threaded for a chuck. The collet rests within the spindle, and there is no overhang. The lever shown at the left of the head, within easy reach of the operator, serves to open and close the chuck and feed the rod. The collet is simple, and for different sizes of stock sets of interchangeable bushings are provided, those for round stock ranging from ½ to 1¼ inches by sixteenths and from 1½ to 2 inches by eighths. Three sizes of hexagon stock—⅞, 1 1-16 and 1¼ inches—are also provided for.

The turret is of new design. It is of steel, circular in form and hollow, with a ledge around the bottom machined out at an angle to form a seat in which the tools are held and forced back against the turret by drop-forged steel clamps on top. This design admits of a large, strong turret and yet one that is light and easily operated, and the tools are held very firmly in place.

In Fig. 2, which gives plan and sectional views of the turret, the annular groove at the bottom, the vertical slots in the periphery which receive the tongues on the tools, and the clamps for holding the tools are clearly shown. As the tools embrace the turret at the back and rest in the groove at the bottom, they are held rigidly with little effort, as any tendency to tilt in any direction is resisted by the locking action of the curved surfaces. A tool cannot rock in one direction without being forced to move in another direction at the same time, and this tends to check all movement.

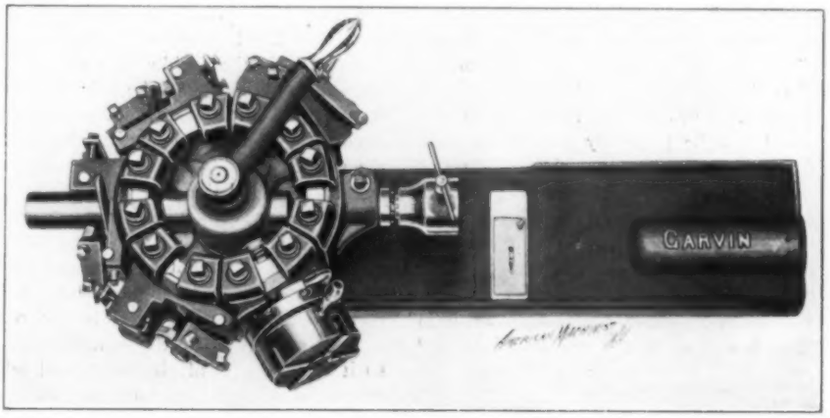


FIG. 3. TURRET AND TOOLS.

The turret rests on a large bearing surface and rotates in a large taper sleeve, giving ample provision for taking up wear. When unlocked, the turret may be freely rotated. A powerful central binder is provided, which maintains a constant position and does not interfere with the free passage of the largest bar through the turret. The indexing is automatic and the momentum of the turret is taken by a stop in the turret base, so that the lock bolt does not enter the turret until the bushing is at rest and in position to receive it, and thus the locking bolt and bushing are relieved of wear and shock and their accuracy preserved.

Fig. 3 shows the turret with a full complement of tools, a piece of stock being shown in one of the turning tools. The compactness and small overhang of the tools is evident and the clear way for the stock through the turret clearly indicated. Each turret tool has an independent, adjustable trip and stop. A cylinder geared with the turret carries six screws and each screw may be set to trip the feed at any point, a slight additional movement then bringing it up against the dead stop. These stop screws are protected and have a range of six inches; and, by throwing a small lever on top of the turret slide, the

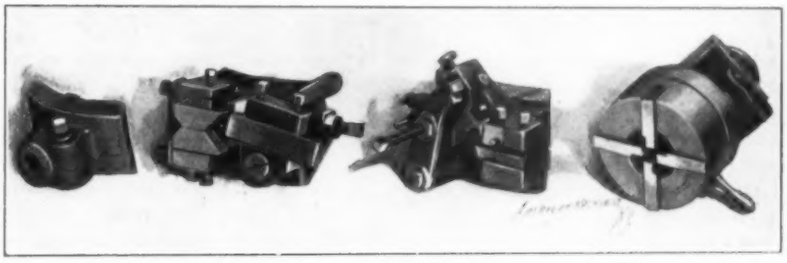


FIG. 4. TURRET TOOLS.

turret may be stopped at any point in its travel of 12 inches.

The turret slide base, which provides a long bearing for the slide, is adjustable along the bed; it is bound by two hook binder bolts and to prevent lifting is held down to the bed at the front where solidity is most essential, by a large bolt.

The feed is driven by means of a chain fitted with a tightener, and a slip friction is provided to present accidents. Changes of feed are amply provided for by change gears. A quick change from fast to slow travel can be made by pushing a knob, shown close to the pilot wheel in front.

The set of turret tools furnished with the machine includes three turning tools, a pointing tool and stop combined, an automatic opening die, and a tap holder. Fig. 4 gives a good idea of these tools. The method of manufacturing them is indicated in Fig. 5, and will be of interest.

FIG. 5. RINGS FROM WHICH TOOLS ARE MADE.

The tools are made of steel castings forming complete rings of six tools of the same kind. These rings are bored out to fit the turret and turned on the top and bottom edges to fit the groove in the ledge around the bottom of the turret and the clamps on top. The rings are then mounted on a plug or arbor and milling cuts are taken on the tools, the ring being indexed for each tool. The drilling for stud holes, etc., is done on the same plan, and a keyway is also cut in each tool. All operations having been done, the tools are then cut apart. The holder shown at the left in Fig. 4, for drills, reamers, taps, etc., and the one at the right, which receives the shank of the die, are bored out in place on the turret.

The turning tool will turn all sizes up to 2 inches, leaving the bar free to pass through the turret. The steady jaws are reversible to precede or follow the tool and are in halves independently adjustable for setting on the center. The cutting tool, which can be taken out quickly, is clamped in a holder swinging on a stud. The holder has a screw adjustment, and a cam handle for throwing the tool into the cut. This permits of clearing the tool when running back or when taking a relieving cut in the middle of a piece. The pointing tool, shown to the left of the die, is provided with steady jaws set at an angle of 45 degrees and adjustable to suit the work. A wide tool solidly supported is used to round the end or bevel the corner of the stock. The adjustable stop for the bar is carried in a swinging arm at the front of the pointing tool and therefore does not require a special hole in the turret. The swinging arm is supported at both ends when in the central position, so it affords a solid abutment, and when swung back does not interfere with the pointing tool in any way.

The die can be set to open at any point. It is adjustable for size and is so arranged that roughing and finishing cuts can be taken. The chasers are well supported and provided in sizes from ½ to ¾ inch by sixteenths and from ¾ to 1¼ by eighths, for cutting U. S. standard threads. Special sizes and pitches can be had to order. The tap holder is really a Horton chuck, fitted with a special shank and sleeve as shown in Fig. 3, which will hold all sizes of taps by the square end, or by the round shank.

The cross slide of the machine is adjustable along the bed, is provided with screw stops thoroughly protected, and carries two tool blocks which are provided with screw side adjustment for setting forming and cut-off tools accurately. The feed is by means of a screw, and broad forming cuts may be taken, the end of the work of course being supported in a bushing in one of the turret tool holders while being formed.

The oil piping from the reservoir under the chip pan is connected to the center of the turret and travels back and forth with it. As each of three of the turret tools comes into position, it is automatically connected to supply lubricant to oil tube drills, etc. A two-way cock is fitted, so that when oil is not needed for oil tube drills it can be led to the spreader to supply the other tools. A stop cock is fitted in the piping, and by closing this cock the pump is always kept primed.

As may be noticed, all the fixed gearing about the machine is protected, and all operating handles located convenient to the operator.

The countershaft has three speeds and is so arranged that the oil pump is driven continuously in one direction. A tool tray with two drawers is regularly included in the machine equipment, and, when so ordered, a taper turning attachment of simple and efficient design and adapted to the full capacity of the machine, can be furnished.

This machine is built by the Garvin Machine Company, Spring and Varick streets, New York city.

F. W. Webb Built Four Thousand Locomotives and Retires.

It is announced that Mr. Francis William Webb is to be relieved from the duties of chief mechanical engineer of the London & North Western Railway Company, which is made the occasion for a sketch of his career in *The Engineer and Iron Trades Advertiser*, from which we abstract a few particulars of general interest:

Mr. Webb, whose connection with Crewe has extended over half a century, with an interval of five years spent in other work, can claim to have built over 4,000 locomotives, turning them out at the rate of 110 to 146 engines every year since 1871, when he succeeded the late Mr. Ramsbottom as chief mechanical engineer. He entered the Crewe works in 1851—eight years after they were established—as the pupil of the late Mr. Francis Trevithick, the first locomotive superintendent at Crewe, and the son of Richard Trevithick, "the father of the locomotive," who in 1805 exhibited his wonderful "steam coach" on land now covered by Euston Station. Mr. Webb was appointed chief draftsman in 1859, and works manager about two years later, a position which he held for five years, resigning it to become manager of the Bolton Iron & Steel Company's works. Five years later he returned to the London & North Western, and has been at Crewe thirty-one years consecutively.

It is as a builder of locomotives that Mr. Webb stands out prominently in the railway world, and his name will be associated more particularly with the construction of engines of the coupled compound class.

Mr. Webb has been in receipt of a salary of £7,000 a year, but he had no royalties on patents, and these were many. He introduced steel locomotive boilers at Crewe in 1872, and not a single case of rupture occurred among 4,000. He designed figure eight and corrugated fireboxes; he invented electric tube cutters; he largely introduced the making in cast-steel of articles which were too expensive to forge, such as wheels, motion plates, brackets, horn-blocks, axle-boxes, and brake hangers; he designed the interlocking of signals, in 1874; and from the signal shop is turned out 6,000 yards monthly of special point rodding designed by him; and in the same department is manufactured the Webb-Thompson electric staff apparatus for single-line working. In a final word, nothing which can concern a mechanical engineer is left untouched by the Crewe works, even to the making of artificial arms and legs for the unfortunate men who lose their limbs in the company's service.

Feeds and Speeds.

BY STANLEY H. MOORE.

The technical student, the designer and the growing machinist, when the subject is brought to their notice, are alike surprised and disappointed at the dearth of definite and reliable information regarding feeds and speeds. In his search for data to present to his students, the writer was unable to secure any on this subject that seemed reliable—that is, based on some law, empirical though it be. This article outlines the method of procedure in the attempt to secure from the mass of seemingly chaotic information some definite knowledge on this subject.

From the pages of technical periodicals and from those of the excellent catalogs which it is the habit of our machine builders to produce, data relative, generally, to the maximum feeds and speeds were separated and tabulated. This was done with special reference to the determining of the best feed and speed to be used in the removal of maximum amount of stock, screw machine practice being used as one of the guide posts in our journey of discovery.

The result at this point was not entirely satisfactory, as the data thus systematized and tabulated revealed the fact that, though it was quite likely that some empirical law existed, it was little understood, for some few of the values seemed either high, low or otherwise.

To discover and ascertain the nature of any existing law was the next step. The data relative to each machining process for a given material were transferred to squared paper, where the curve was plotted; the ordinates representing speeds, the abscissas, the feeds. Brass, being the softest material, was first plotted; its values for turning operations were plotted for the four following reductions: (1) 1-16 reduction in the diameter, ordinary practice and small reductions being here included; (2) ⅛ reduction of diameter; (3) ¼ reduction of diameter; (4) ½ reduction of diameter. The average feed used for small reductions and rapid cutting was found to be about 20 per inch, while that for ½ and similar large reductions was about 100 per inch. The feeds used for ¼ and ⅛ reduction were found to be grouped near what would be the second and third terms of a geometrical progression between these two values.

In plotting our final diagram, the feeds corresponding to reductions of 1-16, ⅛, ¼ and ½ were made 20, 34.2, 58.48 and 100, respectively, *i. e.*, they were arranged in geometrical progression. To these special ordinates were transferred the data for such milling, drilling and planing operations as were made with what might be termed correspondingly heavy cuts; the word reduction in reference to any other operation save that of turning being, of course, a misnomer. After plotting the curves for brass, the task of plotting the curves for cast iron, wrought iron and machinery steel and tool steel proved comparatively easy.

A careful examination of these several plottings seemed to reveal the important fact that not only did the lines for the several operations on the same material radiate from an apparently common origin, but that the lines for these operations for all the materials did likewise—that is, they justified one in assuming that they had a common origin. This being the case, a single plotting was made, the lines being transferred from the four sheets and the values plotted from a common origin. The equation for these curves (straight lines rather) was a step deemed necessary for the compilation of an accurate table of maximum feeds and speeds for these materials. The equations as found and as corrected are given in Table 1:

	Brass.	Cast Iron.	Wrought Iron and Mach. Steel.	Tool Steel.
Turning	$S = -2/3\ F + 106$	$S = -5/12\ F + 66$	$S = -1/3\ F + 54$	$S = -23/120\ F + 34$
Milling	$S = -1/2\ F + 80$	$S = -3/10\ F + 48$	$S = -4/15\ F + 42$	$S = -1/6\ F + 25$
Drilling	$S = -2/5\ F + 64$	$S = -1/4\ F + 40$	$S = -1/5\ F + 32$	$S = -2/15\ F + 22$
Planing	$S = -3/10\ F + 48$	$S = -1/5\ F + 32$	$S = -1/6\ F + 26$	$S = -2/10\ F + 16$

Equations as Found.

	Brass.	Cast Iron.	Wrought Iron and Mach. Steel.	Tool Steel.
Turning	$S = -2/3\ F + 106$	$S = -5/12\ F + 66$	$S = -1/3\ F + 53$	$S = -5/24\ F + 33$
Milling	$S = -1/2\ F + 80$	$S = -5/16\ F + 50$	$S = -1/4\ F + 40$	$S = -5/32\ F + 25$
Drilling	$S = -2/5\ F + 64$	$S = -1/4\ F + 39$	$S = -1/5\ F + 32$	$S = -1/8\ F + 20$
Planing	$S = -1/3\ F + 53$	$S = -5/24\ F + 33$	$S = -1/6\ F + 27$	$S = -5/48\ F + 17$

Corrected Equations.

TABLE 1—EQUATIONS FOR FEEDS AND SPEEDS.

A careful examination of these equations, with due consideration as to the manner in which they were obtained, will justify us in stating that another important fact is revealed, namely, that the various operations possess values and relations irrespective of the materials on which they were performed. To be more specific, assigning a value of unity to turning operations, we may say that the value for milling operations is ¾, drilling ⅗ and planing ½. Here are data that corroborate what we already know, namely, that the lathe is more efficient than any of our other machine tools—how much more, is, of course, desirable information. We might say, too, that it behooves the intelligent designer and foreman to plan the greater part of his work for the lathe, leaving a minor part to be accomplished by the planer.

One more important fact which may be deduced from the equations is the rela-

Diam. of Piece.	CUTTING SPEEDS IN FEET PER MINUTE.													
	10	15	20	25	30	35	40	45	50	55	60	70	80	90
	REVOLUTIONS PER MINUTE, OF PIECE.													
¼	153	229	306	382	458	535	611	688	764	840	916	1070	1222	1376
⅜	102	153	204	255	306	356	407	458	509	560	612	712	814	916
½	77	115	153	191	229	237	306	344	382	420	458	534	612	688
⅝	61	92	122	153	183	214	244	275	306	336	366	428	488	550
¾	51	76	102	127	153	178	204	229	255	280	306	356	408	458
⅞	37	65	87	109	131	153	175	196	218	240	262	306	350	392
1	38	57	76	95	115	134	153	172	191	210	230	268	306	344
1¼	31	46	61	76	92	107	122	137	153	168	184	214	244	274
1½	25	38	51	64	76	89	102	114	127	140	152	178	204	228
1¾	22	33	44	55	65	76	87	98	109	120	130	152	174	196
2	19	29	38	48	57	67	76	86	95	105	114	134	152	172
2½	15	23	31	38	46	53	61	67	76	84	92	106	122	134
3	13	19	25	32	38	45	51	57	64	70	76	90	102	114
3½	11	16	22	27	33	38	44	49	55	60	66	76	88	98
4	9	14	19	24	29	33	38	43	48	53	58	66	76	86
5	8	11	15	19	23	27	31	34	38	42	46	54	62	68
6	6	9	13	16	19	22	25	27	32	35	38	44	50	54
8	5	7	10	12	14	17	19	21	24	26	28	34	38	42
10	4	6	8	10	11	13	15	17	19	21	22	26	30	34
12	3	5	6	8	9	11	13	14	16	18	18	22	26	28
14	3	4	5	7	8	9	11	12	14	15	16	18	22	24
16	2	4	5	6	7	8	9	11	12	13	14	16	18	22
18	2	3	4	5	6	7	8	9	11	12	12	14	16	18
24	1	2	3	4	5	6	6	7	8	9	10	12	12	14

TABLE 2—REVOLUTIONS FOR GIVEN DIAMETERS AND CUTTING SPEEDS.

tion which we find to exist between what we might call the "working texture" of the average materials used in our shops. He who has to do with the problems of cost reduction will welcome this, and kindred data in reference to his stock materials. the writer wishes to convey the idea that this is the feed and speed that will remove a maximum amount of material when due consideration is given to economy and the time required for changing and grinding the tools. These values, it must be remembered, are for materials of average texture and composition, special materials requiring of course special feeds and speeds. Assuming that we have a piece of cast iron two inches in diameter which we wish to turn down to 1¾ inches in diameter—that is, a ⅛ reduction—and, having determined upon the reduction, ⅛, we follow the line marked "Turning" in the diagram for cast iron to its intersection with our ⅛ reduction line; dropping vertically on this line we read our feed 34.2. Passing horizontally from the intersection to the right, we read the speed 52. Having now determined the speed in feet per minute, it is only necessary to determine the number of revolutions that will give to the piece this speed. Consulting Table 2 of "Revolutions for given diameters and Cutting Speeds," we find that our piece must make about 95 revolutions per minute. Table 3 of "Cutting Speeds for Common Reductions" gives the formulas and tabulated speeds as obtained from the charts, it being assumed that this is a more convenient form when seeking ordinary reductions.

While the specific values in the formulas, charts and tables of this article will prove no doubt of great value to many, they should be taken as a guide indicating the conditions existing in the data which the writer was able to procure. As it is impossible for one individual to secure and tabulate that amount of information from the thousands of the progressive machine shops of this country, necessary to indi-

Operation.	Formula.	F = 20 1/16 reduction and average practice on light cuts.	F = 34.2 ⅛ reduction	F = 58.48 ¼ reduction	F = 100 ½ reduction
Turning	S = — 2/3 F + 106	93	83	67	39
Milling	S = — 1/2 F + 80	69	62	50	30
Drilling	S = — 2/5 F + 64	56	50	40	24
Planing	S = — 1/3 F + 53	46	42	34	20
Brass.					
Turning	S = — 5/12 F + 66	58	52	42	25
Milling	S = — 5/16 F + 50	43	39	31	18
Drilling	S = — 1/4 F + 39	35	31	25	15
Planing	S = — 5/24 F + 33	39	26	21	12
Cast Iron.					
Turning	S = — 1/3 F + 53	46	42	34	20
Milling	S = — 1/4 F + 40	35	31	25	15
Drilling	S = — 1/5 F + 32	28	25	20	12
Planing	S = — 1/6 F + 27	23	21	17	10
Wrought Iron and Machinery Steel.					
Turning	S = — 5/24 F + 33	29	26	21	12
Milling	S = — 5/32 F + 25	22	20	16	9
Drilling	S = — 1/8 F + 20	17	16	13	7
Planing	S = — 5/48 F + 17	14	13	10	6
Tool Steel.					

TABLE 3—CUTTING SPEEDS FOR COMMON REDUCTIONS.
Speeds in feet per minute.

It was discovered that when a value of 16 was assigned to brass cast iron had a value of 10, wrought iron and machinery steel 8 and tool steel a value of 5.

Turning our attention now to the diagrams, of which we have three, one containing the data for brass and tool steel, one for cast iron and one for wrought iron and machinery steel, we find them to be to a large extent self-explanatory; however, a few words of explanation may prove of some assistance. The lines

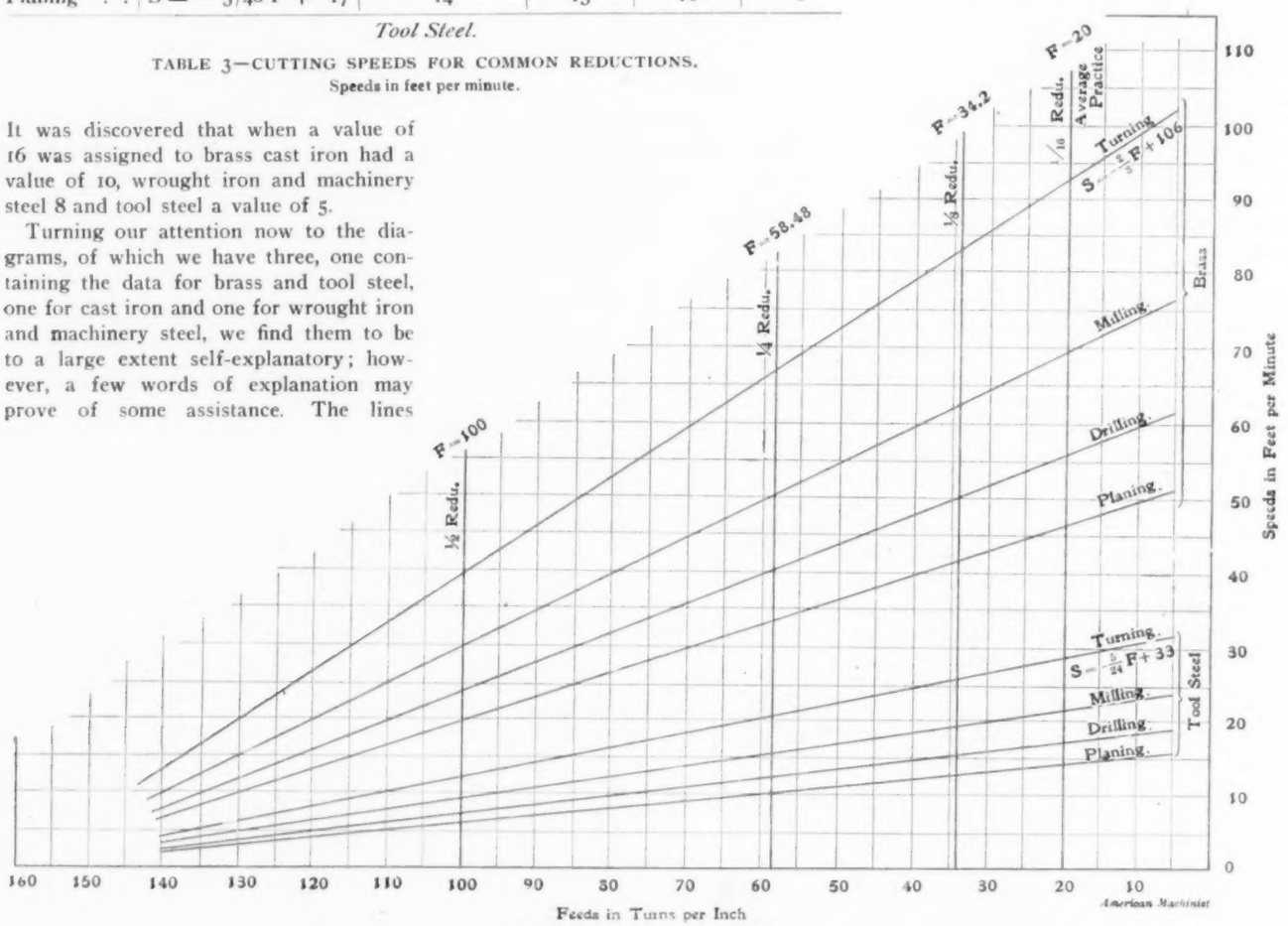


DIAGRAM OF FEEDS AND SPEEDS.

marked turning, milling, drilling and planing, respectively, give the best feed and speed values for a predetermined reduction. By the term "best" feed and speed values

cate the average American practice in this direction, the greatest value of this article may be found in its indication of what may be done with similar masses of seemingly chaotic data.

Echoes from the Oil Country.

TWO POINTS OF VIEW.

One of the most satisfactory things about a machine shop is the genuineness of it. A tool or a machine acts just as well for an apprentice as it does for the expert, if he uses it in as good a way; so it is easy to judge skill by results.

The laws of mechanics are as true for one as for another, and they can be learned and brought into subjection by anyone having opportunity and patience; still the opportunties may come as a result of other things than an aptitude for mechanical pursuits. Things are not always what they seem even in a machine shop.

The shop was not one of those big establishments like you see the pictures of, but it was a pretty fair shop and did good work of its class, and it found so many people that wanted what it was making that it began to be so far behind that ordinary overtime did not fill the bill, so it was decided that a night gang was the best way out of it.

Not wishing to cripple the day force, all new men were put on the night gang, and as the town was a small one, and as all the machinists in it were busy, everything that came along claiming to be a machinist and wanting work was picked up and dumped on to the "night boss."

I am not just sure what the considerations were that decided who to put on as night boss. One man who was *not* put on hinted that they took the one that could be spared the easiest from day work, while another mildly suggested "That's a pretty tough gang, but the boss is so small that they would all be ashamed to hurt him, and he couldn't hurt them if he tried to." However, it *was* rather a tough gang and the boss was small. He was so very small that he realized from the start that if he got along with that crowd he must do it in some way not requiring muscle.

The one thing he particularly disliked was the drinking of some of the men, but by careful watching he managed to keep this down, and the men understood that they must be reasonably sober when they came to work and not have any liquor during working hours.

From twelve to fifteen men were usually at work, although more were wanted; but

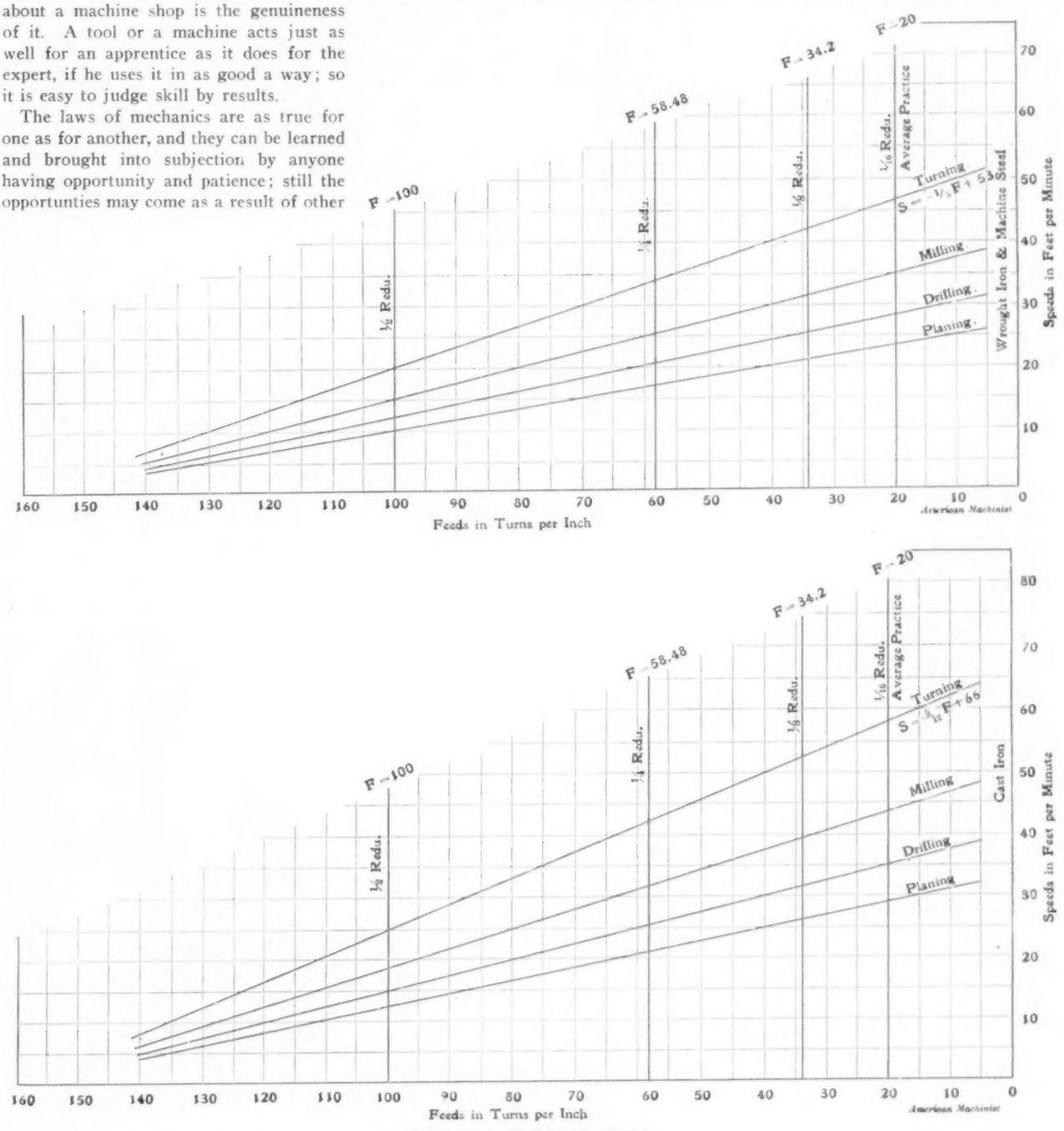


DIAGRAM OF FEEDS AND SPEEDS.

by the foreman's discharging some and by some quitting that seemed about the limit. Some men were kept and allowed to work who under less pressing conditions would not have been tolerated.

After running a month or so a pretty fair gang had been gotten together. Among them was one very large, powerful young man who ran the large planer. This man had an education and a general air that was unusual, and was one who would attract attention almost anywhere. As he took readily to any suggestions offered and had lots of ideas of his own, the foreman often used to stop by the planer and talk over things with him, and they soon got to be good friends.

One of the habits that the foreman had was to do all of his talking to the men in a very quiet way so that the other men could not tell whether he was finding fault or praising or offering a hint or receiving one. This he thought best, as it often saved the feelings of men who had blundered in their work and had to be gone to about it.

He had heard rumors that Mac, the big fellow on the planer, got on an awful "tear" once in a while, and that that was why he worked as he did; that his people were rich but disliked him for his evil habits and left him to shift for himself. No doubt the men heard a lot of talk that the foreman did not.

One night Mac came in rather the worse for drink. The superintendent was still in the shop and saw him before the foreman did, and, approaching the foreman, he remarked: "Mac is some off his base, but I think he will be all right in a little while. Just watch that he hasn't any bottle. We need his work, and if you send him out he will go on a spree that may last for two or three weeks."

Real good planer hands were not very plenty just then.

Shortly after that there was a crash at the planer. Mac had started to raise the cross rail, but had lowered it instead. The planer was running at the time and the work had caught the tool head and torn it from the saddle and smashed the jig that held the work. That meant a good big job of patching and no work on the planer that night, and Mac put on his coat with "Well, I guess I did it that time, and I may as well go out again"; and he laughed as he started for the door while the foreman started in on the repairs.

At midnight the shop stopped a few minutes for lunch and the foreman was sitting on his bench near the planer eating his lunch, when Mac came in. Evidently he had made use of his time filling up, as he could not walk straight. After looking at the planer a minute, he came over to the bench and stopped before the foreman:

"Do I have to pay for breaking that planer?" he asked.

"I really don't know, Mac," the foreman answered; "that is between you and the company."

Mac leaned forward and, raising his huge fist and shaking it in the air by way of emphasis, whispered, "I'll never pay a cent." Shaking both fists he went on, "All the devils in hell couldn't make me pay anything."

"I'm sorry it happened, Mac," said the foreman.

"You treated me like a gentleman, and I liked to work for you, but," and he straightened himself up and struck an attitude of defense, "I'd fight that —— company till I die before they would get one cent." And so he went on, alternately expressing his good will to and admiration for the foreman and his hatred of the company, punctuating it with the wildest sort of gestures.

Sometimes he would walk away a few steps, and then, as he thought of something, would wheel around and rush back and pour out some bitter message that he wished conveyed to the company.

Several of the men had come over and sat down near by, as the foreman thought, to hear what was going on. As the engine was running and it was time to be at work, the foreman was wondering how he could get Mac out without trouble.

As he finished his lunch and set his basket to one side, he slid off the bench and slipped his arm through Mac's:

"Come, now, Mac, I want you to do me a favor. You know it always disturbs the men to have visitors around, so I want you to go out for the rest of the night. You never refused to do anything reasonable for me yet."

"And I'm not going to refuse now," said he, starting for the door. "I'd do anything for you. You treated me decently, but—," and he had to stop and shake his fist over the foreman's head and express his opinion of companies in general and that company in particular.

"I suppose I'll have to work here until I can do better, but I know you will help me what you can," the foreman said, as he gently urged him toward the door.

After several efforts he was landed safely outside and started up the street and the foreman went back. In passing down the shop one of the men remarked to him: "I've seen a good deal of nerve, but that beats it all."

"What do you mean?" thinking something was wrong.

"Any man that can sit up on a bench and quietly eat his supper while a great big drunk giant threatens his life has nerve enough, but to see a man of your size take him by the arm and put him out beats me."

It suddenly flashed on the foreman how it might have looked to the men who had only seen the motions and could not hear the talk, and he laughingly replied:

"I finished my supper and got him out, didn't I?"

"You did, but I wouldn't have done that for all the money the shop ever made. Just suppose he had hit you; we couldn't have pulled him off before he had killed you. We got up as close as we dared to, but one blow would have fixed you."

"That would have given some of your fellows a chance at a bossing job; but really I was not in any danger so long as I didn't excite him."

"Maybe you wasn't, but I don't want a new boss; I'm only getting acquainted with the one I have now, and I promise you I'll never come near the shop drunk."

A little inquiry showed that the general idea was that Mac had come in to clean out the shop and would have tried to do it if he hadn't been headed off by the foreman. The foreman thought otherwise and found that of all the men that worked for him on the gang only one ever gave him an uncivil word, and that one was very drunk at the time and had the name of being a thug; yet he went off quietly after finding his vile talk did not bring a return in kind.

As this gang was not a model one by any means, and as many of the men were found unsuitable and had to be discharged, the foreman's place was not the most pleasant one, but he couldn't see the use of making it worse than it was.

I had an illustration once.

"We need another man badly; do you know where to get one?" It was the owner who was speaking to me.

"I might get Jack; he isn't working," said I.

"Jack would be all right if you could only keep him sober, but I don't think it's much use trying," said he.

"I think I will try once, anyhow," I answered, and went to hunt him up.

Jack was a fair workman and noted for always getting drunk when he was wanted the worst and when the job was in the biggest hurry.

"Say, Jack, I need a good man; where can I get one?"

"I'm not working; how will I suit you?"

"You'd do first rate only for one thing: I'm afraid you would go to drinking and I'd have to 'fire' you, and I hate to fire men worse than anything I have to do."

"I'll promise you I won't drink a drop while I work for you on the job."

"Shake on that if you mean it, and come in in the morning."

Jack shook hands and came in and worked six weeks, which was as long as the job lasted, and kept his word.

Several months after that we again needed a man and the owner met Jack and told him to come to work. Jack came, and after a few days went on a spree. I met him and, stopping him, said:

"How is this, Jack? I thought you wasn't going to drink when you were working for us?"

"Hold on there, now. I didn't promise anybody anything on this job. There didn't anybody asked me to, but I kept my promise to you, didn't I?" And I had to admit that he had. W. Osborne.

Feeding Sheet Metal to Dies—I.

BY JOSEPH V. WOODWORTH.

HAND, SINGLE-ROLL AND DOUBLE-ROLL FEEDING.

In the production of parts and articles from sheet metal by the use of dies in the power press, the proper feeding of the stock is one of the chief things to be considered, as the value of the finished product and the cost of its production depend greatly upon the methods employed. Sheet metal goods manufacturers strive to keep the cost of their tool equipment down to the lowest figure, and are slow to avail themselves of the many practical devices which are being constantly added to for the cheap and rapid production of sheet metal parts, yet they would find that by installing a thoroughly practical system of feeding the safety of their operators would be insured and their profits increased.

The improvements which have been made during the last few years in devices for press feeding are astonishing. There is not a sheet-metal part in general use to-day for which some one of the large establishments devoted to the manufacture of sheet-metal machinery cannot provide an automatic feeding device. In this and other articles that may appear under this title, it is the intention to illustrate and describe the various devices which are used for the feeding of sheet metal to dies. We will here show the most approved types of single- and double-roll feeding devices.

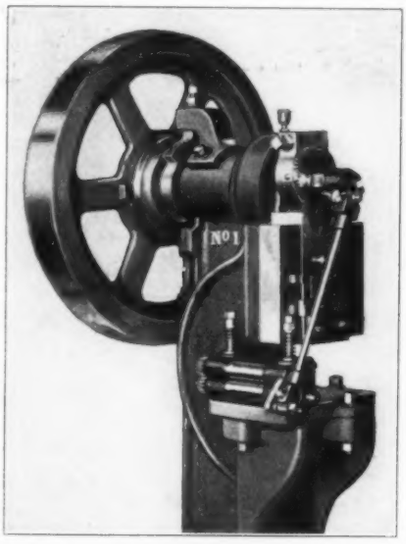


FIG. 1. SMALL PRESS WITH SINGLE ROLL FEED FOR SIDE FEEDING.

As to a certain extent the presses on which feeding devices are used form parts of the devices themselves, in regard to working them, etc., we have thought best to illustrate them in connection with the presses on which they are used. This will contribute to a clearer understanding of the design, use and action of the devices than if they were shown alone. Very often presses are built specially for the devices which are to be used for feeding the stock.

The most common and the oldest method of feeding sheet metal to dies is by hand, and often it is the best. When the metal comes in short strips or sheets, or when "scrap" stock is used, it does not pay to feed it automatically. When the metal is fed by hand it should be fed between

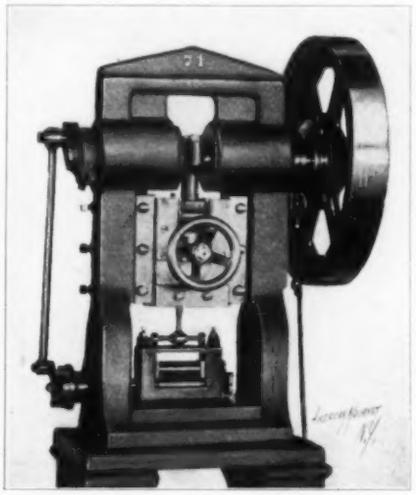


FIG. 2. PRESS WITH SINGLE ROLL FEED AT THE BACK.

a pair of gage plates (or against a single one) on the die, against a stop-pin, as shown and described in preceding articles by the writer. But wherever the nature of the work will permit, an automatic feeding device actuated by the stroke of the press should be used. In the following are shown a number of types of automatic roll feeding arrangements now in common use.

When large quantities of pierced blanks, plain blanks, shallow drawn or formed articles which can be produced in one operation, or other small work of a like character is to be made, and when the stock can be had in long strips or in rolls, a press should be fitted with a single-roll feed like the one shown in Fig. 1. In such feeds a pair of feed rolls are actuated by an adjustable connecting rod from the press shaft, giving them an intermittent motion, feed the stock across the die face while the punch is up and remain idle while the blank is being punched. The feeds are to be had in a number of different sizes to suit the size of the press and the nature of the work, and they may be used to feed from front to back, right to left, or *vice versa*. The feeds are made with rolls of various sizes with an automatic stop or release action for the upper roll, and are equipped with hand wheels. The distance which the stock can be fed at each stroke of the press is governed by the size of the rolls and the adjustment of the feed lever.

Fig. 2 shows a different type of single-roll feed and its adaptation to a larger press and of different design. The slide of this press is provided with a wedge adjustment actuated by a hand wheel in front. The upper feed roll may be released quickly or raised by means of an eccentric handle, permitting the strip of metal to be accurately placed, released and readusted at any time. In this device a pawl operates on the edge of a toothless disk, taking its "bite" by means of a wedging action, which permits of easy adjustment and fine spacing. A machine equipped with a feed of this type is very useful for bicycle chain work, clock and watch parts, Yale lock and key blanks, and many other articles of a like nature. A great deal of sub-press work is done on presses of this design equipped with feeding devices of the type shown. The use of the sub-press is provided for by making the distance from the bed to the bottom of the ram when up sufficient to give room for the sub-press.

Roll feeds can be used to great advantage in the production of accurate pierced blanks from the strip, such as bicycle chain links, washers, clock and watch parts, electrical apparatus, etc. The presses are usually single acting and the double-roll feed used is shown in Fig. 3. Combination gang dies are used, the piercing being done first and then the blank cut out, from 100 to 150 blanks being produced per minute. The action of the feed rolls when used

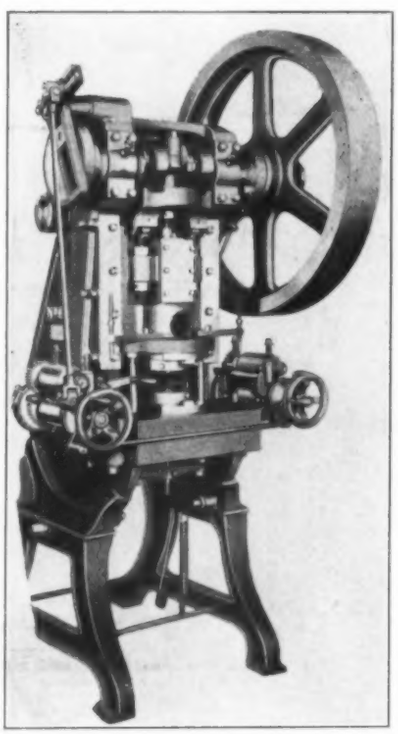


FIG. 3. A DOUBLE ROLL FEED AND AUTOMATIC ROD RELEASE ON DOUBLE-ACTING PRESS FOR MAKING SHALLOW DRAWN SHELLS FROM THE STRIP.

for work of the kind here mentioned is as follows: At each stroke of the press, at the instant when the pilot pin, or pins, as the case may be, located in the blank-

ing punch are about to enter the holes pierced at the first stroke, the upper feed rolls are automatically raised so as to release the strip of stock and permit the pilot pins to shift it into the correct position, correcting any slip which may have occurred in feeding and thereby overcoming and preventing the multiplication of error. By means of the hand wheels the strip may be quickly fed to the starting position and the last end quickly removed.

The press shown in Fig. 3, on which a feed of the type mentioned above is located, is a double-acting one and is equipped with a "push through" blanking and drawing die. This figure illustrates the manner in which the double roll feed is adapted for the rapid production of shallow drawn shells from the strip, cutting and drawing at one stroke of the press. A section of stock as punched and two of the shells are shown on the floor beneath the press. From 60 to 100 shells per minute may be produced by feeding in this manner. The roll feed is easily adjusted to blanks of different sizes, as will be seen from the scope of adjustment in the actuating feed rod. Both of the upper feeding rolls are provided with cam-actuated lifting devices and hard levers, permitting of opening the rolls at any time for readjusting the strip.

Fig. 4 shows a single-acting power press arranged with a special combination of roll and lateral feeds, with dies for embossing, blanking and forming tin staples from roll of stock (usually placed on a reel at the front of the press). This illustrates a method of combining feeds for automatically producing embossed, small, formed parts from strip tin or brass.

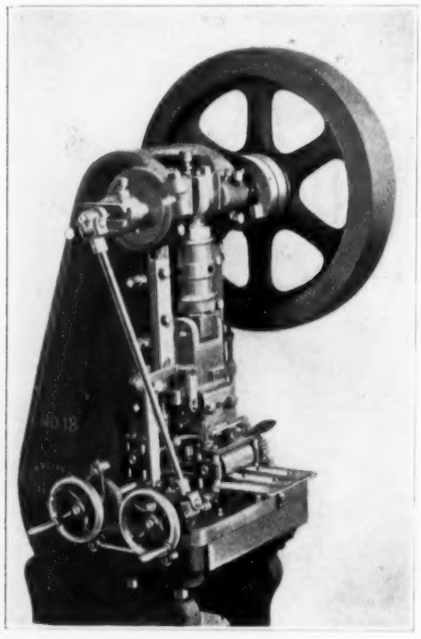


FIG. 4. PRESS WITH DOUBLE ROLL AND LATERAL FEEDS.

A favorite method of combining roll feeds for feeding stock which is to be perforated, such as sheets which are to be perforated in regular patterns by means of a double "gang" of dies, is to arrange them on the press so that one set will be at the front and another at the back, thus allowing the sheets to be perforated very close to the end. With feeds arranged in this manner on a press of suitable design from 70 to 100 strokes a minute may be attained, and, feeding the metal through the rolls, will allow of punching a double row of holes at each stroke of the ram across a plate from 14 to 30 inches wide. When feeding devices are arranged for work of this kind, the feed roll housings are hinged and each set of rolls has a hand-wheel to allow of quickly adjusting the sheet at the start, or removing it at the end. The rolls are actuated by a lever connected at one side of the press, one end to one of the lower feed rolls and the other to an adjustable stud in a T-slot in the end of the press crank shaft.

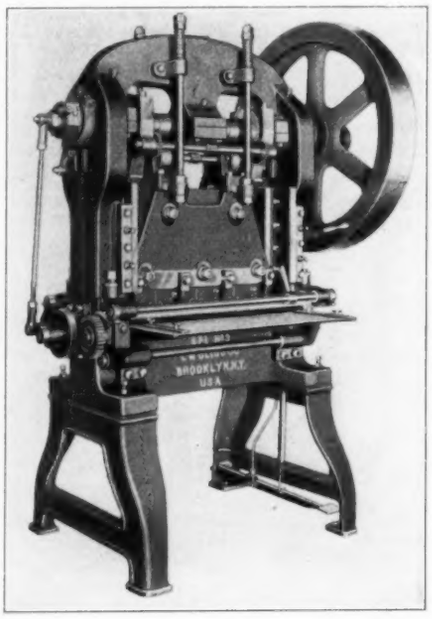


FIG. 5. PRESS AND FEED ROLLS, BOTH AT THE FRONT AND BACK.

In Fig. 5 is shown a press for perforating sheets of steel 1-16 thick, 30 inches wide and 101 inches long, punching a line of holes entirely across the sheet at the rate of eighty strokes per minute. Fig. 6 shows the front feed rolls and apron let down to allow of setting and adjusting the dies. As the holes pierced in the sheets were of small diameter, necessitating very frail punches, a stationary stripper is not used, but instead a cam-actuated stripper worked by cams on the crank shaft. This stripper permits the use of shorter and therefore much more durable punches than can be used with stationary strippers. The stripper on this press comes down upon the stock, straightening it out before and holding it straight during the punching and stripping. After the stripping it moves up with the punches. This arrangement presents the additional advantage of avoiding the blow against the lower slide of the stripper-plate, which with stationary strippers occurs upon the return stroke of the slide, because of the necessary play between the face of the die and the fixed stripper which allows of the punched plate or strip to be carried up against the plate before stripping. This well-known cause of broken punches and sheared dies is entirely removed when a device of this type is used. With the press equipped as here shown, 180 sheets of the dimensions given above were perforated per day of ten hours.

The roll feeding devices illustrated herein represent only a few of the many in general use. However, the number is sufficient to convey an idea of their use and value in producing sheet metal parts at a low cost and to a high degree of accuracy and interchangeability. For special work special combinations of feeds have to be arranged.

Letters From Practical Men.

Shop Nomenclature in England.

Editor American Machinist:

Osborne's discourse on shop nomenclature, at page 1539, reminds me of an incident—or shall I say accident?—which occurred during my residence in Yorkshire, England.

.We required a pulley to complete an urgent order and found at the last moment that the only one in stock of requisite size was too large in the bore. The pulley was handed to a turner with instructions to bush it, the bush to be fitted in "flush" with the boss at each side.

Upon examining the finished job I found to my surprise that the bush had been left slightly projecting, and to improve its appearance time had been wasted in nicely rounding off the corners and polishing the projecting parts. As the pulley was required to present a specially-made-to-order appearance, this was annoying, as the extra polish and odd appearance gave the game away at a glance. I quickly sought an interview with our man:

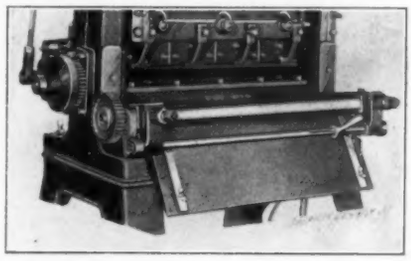


FIG. 6. FRONT FEED ROLLS AND APRON LET DOWN.

"I see you've finished that pulley, but you'll have to mount it up again and turn the bushes off flush with the boss. Why didn't you listen to orders?"

"But I've turned it flush."

"Indeed; then if you did, it's suddenly swelled out."

"What do you mean by flush?"

"Why, level, of course!"

"*I* always understood it to mean proud, standing out."

"You're the first man I've come across who thought that; why, it's an extremely common word."

We discussed the matter at length, and at last he persuaded me to take a "consensus" of the shop's opinion. I did so—not all at once, though—and found to my astonishment that fully 50 per cent. were entirely at one with the turner. There was absolutely no unanimity.

Now the word itself certainly gives one the impression of fullness, as an overflow of water, a flushed countenance; but I have still grounds to base my own reading upon so long as the dictionary meaning is "level, with respect to surface."

I don't much object to hearing the tailstock called the footstock, a dead center or a poppet head; a spanner, a nut wrench or screw key; the lathe bed, a gantry; a standard, a leg; machine platen, a table; planer down slide, a fiddle, by reason of its shape; the mandrel, the spindle; an angle plate, a knee or elbow plate or bracket; but when it comes to calling the grindstone, a grindlestone; a slide nut, a box; a screw, a pin; a pin, a peg; a swivel, a quadrant (¼ circle); a drilling machine, a drill press (how does it press?); the planer cross slide, a cross rail (there's no wheel on the square slide which rides upon it); a gear wheel, a cog wheel (the days of cogging are past and gone, for rawhide is better); I object just as much as when the wife calls all the polished iron about the household furniture "steel work," the furniture man his veneered rubbish, solid oak, or the butcher man his frozen foreign meat, "best English."

I recently made my appearance as a resident and worker in Birmingham, and it has taken me all my time to measure the meanings of the many shop terms used here—and even now I often forget myself and call a screw a screw, a pin a pin, and a nut a nut.

In these parts there do not appear to be any small screws. Anything threaded under a foot or so in length is always a pin; and so we have cheese head pins, mushroom head pins, collar head pins, set pins, chuck pins (the jaw-actuating screws), slide pins, and so on; and hence screws, not being screws, but pins, pins themselves are relegated to the "peg" list. And so the journey of Miss Pin from the makers to the users constitutes by law of custom a marriage, and the maiden name of pin is changed to that of peg.

On looking over an outline drawing of a countershaft, I came across a remark somewhat like this: "This pulley to be pinned on, not keyed." As the bosses (hubs) were not shown projecting from the edge of the rim, although there was ample room, and as on a countershaft it is advisable to be able to adjust the pulleys to the machine, and not the machine to the pulleys, I did not see the force nor the meaning of the remark until the words were translated into the correct English: "To be secured by a square head set-screw."

And for some time I was in doubt upon seeing the phrase "to be pegged on" as to whether to conclude that a pin should be put clear through the boss and the shaft, or whether a simple, short peg should be driven into a hole drilled in the shaft and the boss held by a short keyway cut at one end of the hole.

Although I had at times heard the word "box," used to express "nut," still even now it always strikes me as being incongruous.

Here, too, lock-nuts, lock-collars and ordinary shafting collars are lock-*rings*. Swivel slides are quadrants (whether they bear a resemblance to a quarter circle or not).

Now, seeing that such diversity exists, is it not high time that some common—and expressive-of-its-meaning—nomenclature be adopted? No doubt in the old days could be pleaded the excuse of shop customs and usages being as unalterable as the laws of the Medes and Persians, but to-day, the days of the universal use of drawings in the shop, never.

Let the draftsmen be unanimous in the naming of parts on the working drawings, and the men will perforce by constant usage quickly follow suit.

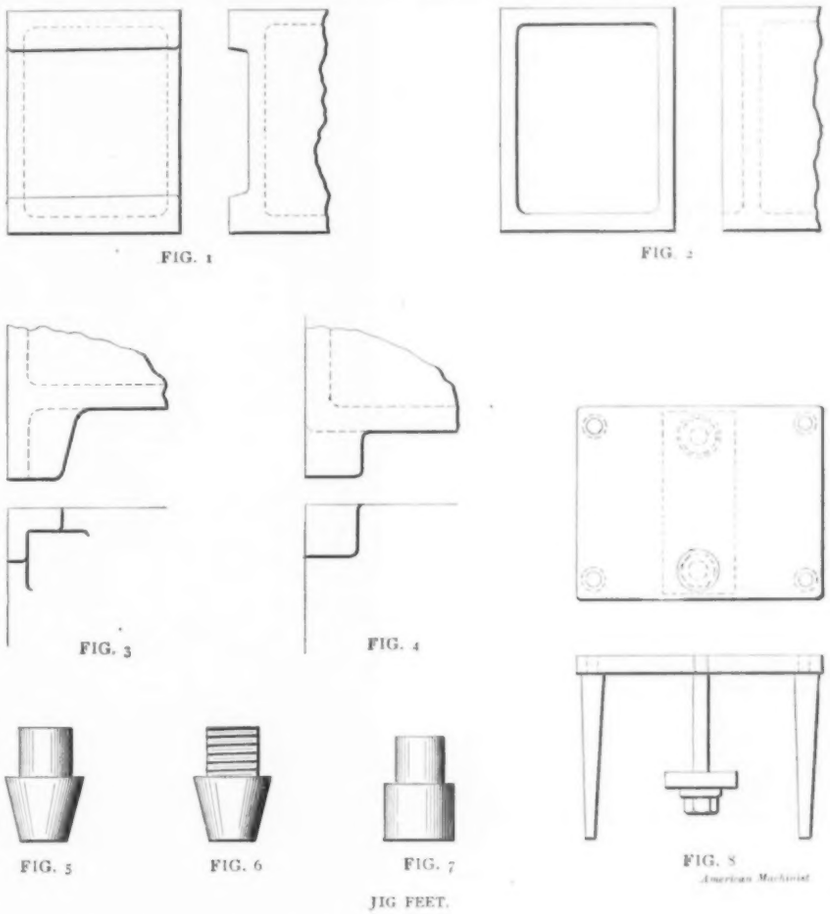
FRANCIS W. SHAW.

Birmingham, England.

Jig Feet and Bushings.

Editor American Machinist:

The article at page 1373, "Some Points in Jig Design," by L. O. Danse, has been read by me with considerable pleasure. Especially interesting are his remarks on jig feet. There are, I believe, nearly as many kinds of jig feet as jig draftsmen, each of the latter seeming to have his own ideas on the subject. And now and then one runs across a man who, like the manufacturer Mr. Danse mentions, wants no feet at all on his jigs, claiming that they are always getting into table slots and holes and are therefore a nuisance.



JIG FEET.

I worked at one time for a man who was always worrying about those slots in his drill-press table, and who insisted on having the bottoms of his jigs made as in Fig. 1 or 2. Thus he struck a happy medium between plain flat surfaces and jig feet.

Some of the people who don't care for hardened feet in their jigs cast the feet integral with the body, as in Figs. 3 and 4. Either makes a good foot; the one shown in Fig. 4 being, of course, the easier to make and probably just as good as the other, except where a foot of considerable length is required.

When it comes to steel feet, all sorts and sizes seem to be used, and Figs. 5 and 6 show two tapered feet, one of which drives and the other screws into place. Why are these feet tapered? So far as I can see, they are no better than plain feet and more bother to make. As for the thread on Fig. 6, that also seems entirely unnecessary. I usually make a foot as shown in Fig. 7. It takes little stock, little time, and when in place is as good as the best, so far as I have been able to judge.

It has been my good fortune to see something of the jig work in a number of shops, and the strangest type of jig I have seen in my travels is the "grandaddy-long-leg" affair shown in Fig. 8. Why anyone should think that a flat steel plate mounted on stilts, and provided with the necessary straps and bolts for holding the work, is cheaper in the long run than a properly designed jig, I cannot understand. I've seen quite a number of such jigs used, however.

I wish to shake hands with Mr. Danse on the machine-steel bushing question. I've tried hard, in at least two places, to get them to try machine steel for their bushings, locating devices, etc., but had to give it up. Perhaps someone will tell us why a bushing made of machine steel and properly case hardened should not answer the purpose as well as one of tool steel.

S. F. ARTHUR.

Mechanical Schools.

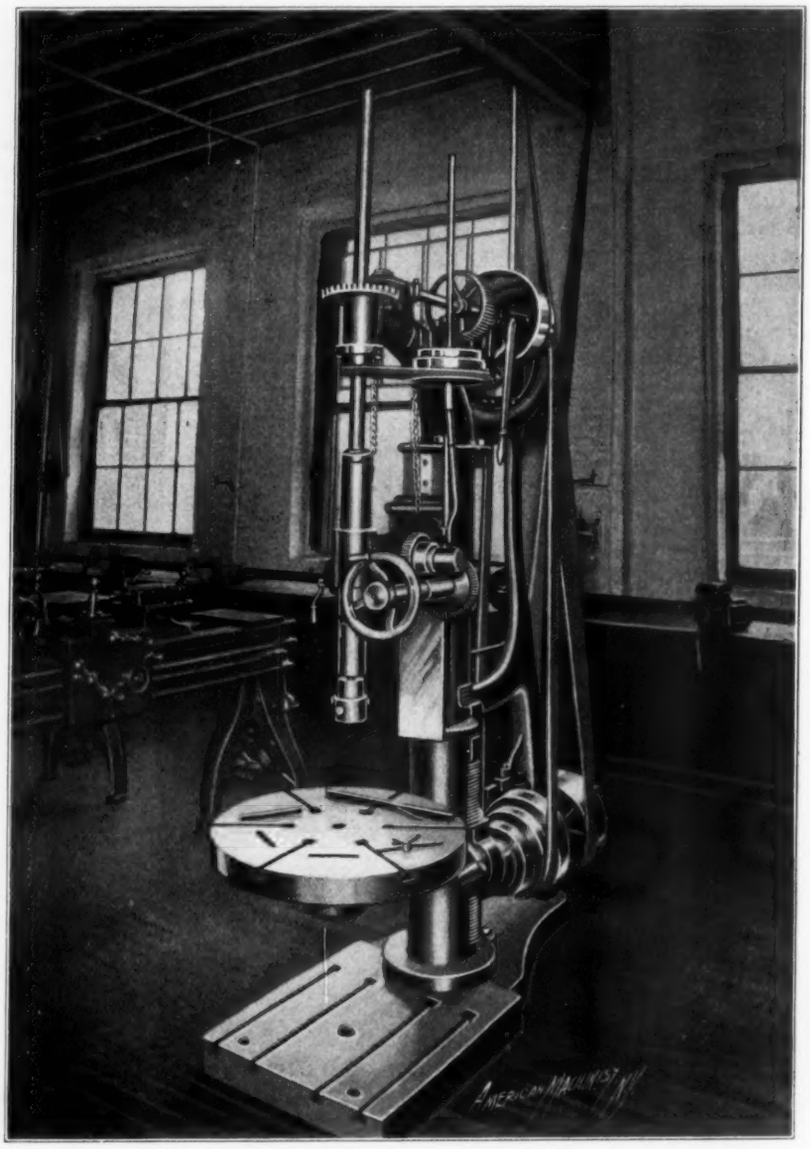
Editor American Machinist:

The articles appearing in your paper during the past few months on the subjects of technical schools and manual training have interested me greatly, as I am a graduate of the one and a teacher in the other. I have been several times tempted to have my say on these subjects, but as other matters were pressing I held my peace. The time has now arrived, however, when I must speak my mind if I may be permitted to do so.

It was my good fortune to get into a school where the use of scales was both understood and taught, whatever other shortcomings the institution might have, but the thing that induces me to write is the criticism offered by S. P. Y. at page 1656 on the work done by the senior classes in some of our industrial schools.

Goodness knows that much of this work is poor enough, and it is also well known that skilled mechanics are employed in some institutions of this kind to do work which is shown as the work of the school; but it seems to me that it is a pretty broad statement to say that young men, fourteen to seventeen years of age, cannot build such machines as gas engines and dynamos. The writer has worked in several shops, including one of the best known in this country, and he has seen young men of the ages above mentioned, not only roughing out but finishing parts of just such pretentious machines as those named, and if these young men can do such work in the shop, what is there to prevent them from doing similar work in school, provided the instructor understands his business? To be sure, he does not understand it in many cases, but it is not his fault, poor fellow. The salary is ridiculously small, and no self-respecting mechanic would work for such a compensation. Fortunately, however, these conditions do not prevail in all schools.

The accompanying photograph shows a 28-inch upright drill press which was built by members of our senior class, and it has been in use for nearly three years, giving good satisfaction. The boys made the drawings from sketches furnished by the instructor; the first-year students made the patterns and the middlers made the forgings. The castings were made elsewhere, and the base-plate and table, being beyond the range of our tools, were machined where they were cast.



AN EXAMPLE OF SCHOOL SHOP WORK.

Our reason for doing such work is twofold. We believe the student gets far better training from such work than would be possible if he were kept making more exercises after he has learned the fundamental principles underlying the use of ordinary machine tools. He takes a greater interest in his work when he is making something useful, and if he sees fit to become a practical mechanic he has a good foundation on which to build. If anyone doubts this, let him inspect our work and see for himself. Secondly, we can be constantly adding to our equipment.

Our students have also built an eight-day tower clock, which has been in successful operation for seven years, and they are at present engaged in making another clock which is to have a 13-foot dial and the striking part is designed to ring a 7,000-pound bell. It is also fitted with a set of chimes which strike the quarters. This work is done entirely by students, and, so far as we know, their stock of self-conceit has not outgrown the ordinary limits of human nature.

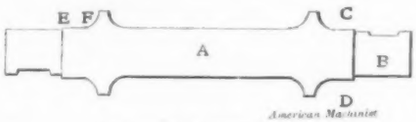
WILBERT S. DREW.

Chicago Manual Training School.

Local Case Hardening.

Editor American Machinist:

I was very much interested in the article by "Cherry Red," at page 1490, on local case hardening. He describes a good way of hardening cycle axle ball races. I have no doubt but that it is a good thing under certain conditions of manufacture; but in advanced practice in the production of cycle axles they are turned on automatic machines; therefore cutting them off, as described by "Cherry Red," from a black bar of steel, turning the ball race only and carbonizing before proceeding further, would be impracticable under these conditions. The automatic machine produces the axle completely turned, with the exception of a skim to be turned off on an ordinary lathe to insure acuracy of finish. Under this condition it is advisable to pack the center *A* with fire clay in the ordinary way, and carbonize from the ball race outwards. Then, to overcome the shearing off of the metal of the cotter pin



LOCAL CASE HARDENING.

through friction, owing to the hardness of the axle, dip the end of the axle in a red-hot lead bath, allowing the color to rise from the end of the axle towards the ball race. The color at *B* will be a deep blue. Then dip in water. The end as far as *C D* will be comparatively soft, perhaps in some instances tempering the ball race slightly, which would be an advantage. However, the tempering of the ball race can be easily avoided, if desired, by exercising a little judgment. The best way to true the axle is to place it on two blocks under a press, and a slight pressure will straighten it. After this operation, if first-class work is desired, it is necessary to grind the shoulder and ball race from *E* to *F* to insure a good bearing. MACHINIST.

Birmingham, England.

Technical Education.

Editor American Machinist:

There has been much discussion of late in the technical press about technical education. So far the letters seem to be mostly, if not entirely, from those using or employing men possessing such education, and those imparting such education have remained silent. The writer, being what is termed a technical man and having worked through all the stages of blueprint boy, tracer, draftsman, designer and chief draftsman, as well as having conducted his own drafting office, thus employing and managing draftsmen, many of whom were recent graduates, feels qualified to speak on the subject of the recent graduate.

First as to the graduate himself: He is a man of more than average intelligence, much of whose time for four years has been profitably spent. We *should* be able to say *all* of whose time, but we are not under present conditions. Any employer of the recent graduate knows how great are his shortcomings due to the many things left untaught, and the many things taught wrong that have to be unlearned and learned over again. The untaught and the wrongly taught things are due entirely to incompetent teachers, many of whom are but a few years removed from the classroom themselves, and have no practical knowledge of how things are done in commercial life, nor any idea as to what is expected of the graduate as soon as he enters the commercial domain.

Such teachers know nothing of shop methods or systems, how orders are obtained, entered and passed through the office, where they go from the office, or how they get to the drafting room, in what manner or from whom the shop gets its instruction; the manner the work is traced through the various shops till it is ready to ship; the getting or giving of shipping instructions, the requisitions for, ordering of, and invoicing of raw material; the purchasing department, the stock room, cost keeping, time keeping, the pay-roll, the relations one to another of apprentice boys, journeymen, foremen, superintendent, mechanical engineer, chief draftsman, etc., in fact what may be called the economics of commercial manufacturing. The teachers of the school *shops* are usually commercial men, in very great contrast to the classroom teachers, and it is owing to this fact that the recent graduate can tell when a tool is dressed properly, but not when a drawing is dimensioned right. Very few graduates expect to spend any time in the shop, while very many—probably a great majority—do expect to begin work in the drafting room and spend considerable time there.

The graduate has been taught the theoretical impossibility of taking a drawing off the board and expecting to replace it with the lines square. The teacher doubtless believes in this theory, little knowing the necessities of the commercial drafting room, where a drawing is handed from draftsman to tracer, where a draftsman may be required to jump back and forth from job to job a dozen times a week, and where "good enough" is many times more valued than "too well done."

Their ideas are disconnected, strung upon no thread. They make drawings impossible to mold or machine, although, when attention is called, they recognize the fact readily enough, showing that while they were taught the rudiments of shop practice and drafting, no connection was made between the two. In the school they made drawings, made patterns, made castings and machined them, but were not taught that the patternmaker had any interest in how the draftsman did his work, nor the molder in the patternmaker's work, nor the machinist in the work of either one. Drafting seems to be taught as an entirely separate and disconnected subject, like anatomy. It is only when one gets far enough away from his own course to get a clear perspective view of it that one sees how many things could have been better done, and how many done that were not done at all, that one realizes the lack of proper teachers in the schools.

The recent example of bad drawing published in the AMERICAN MACHINIST is little worse than some that the writer has seen come from the recent graduate. One particularly bright graduate, well recommended by his school, spends an hour trying to locate a proper center from which to shade a particular circle. Would it have taken any longer for his teachers to have taught him how to shade a circle by springing his compass than to have him stabbing around after centers? And would not the chief draftsman have thought better of him if he had known how to shade a circle after four years' study?

Now why not organize our schools like a shop or manufacturing establishment? Let the dean of the school represent the general manager, the professor of engineering the mechanical engineer, the instructor in drawing the chief draftsman, and have a superintendent of shops. Have everything run on a shop system. Let each boy make out his time card at the end of the period, whether in drawing room or shop; let each piece a boy makes be given a job number which shall originate in the drawing room.

Let the boys see orders coming from the general office in the nature of specifications. Let them see these specifications digested by the chief engineer, and handed to the chief draftsman with instructions. Let the boys then be required to complete the drawings needed, and issue the shop orders, as well as catalog and file the tracings, specifications and other matter pertaining to the job. Let the boys in the shop receive these instructions from the drawing room through the shop foremen, and work accordingly. Let all the routine of record keeping according to some system be gone through with, giving each boy a chance to get familiar with the same. Abandon much of what is called the optional courses, and substitute a course in shop management, to include cost keeping, invoicing, selling and factory systems. It is the writer's experience that optional courses usually degenerate into college playthings to fill in time, and at the best mislead the student into thinking he is acquiring useful knowledge, while the time could be spent in learning much that the employers insist on having, and which now must be learned after graduation, to the financial disadvantage of the graduate.

In a recent editorial the AMERICAN MACHINIST covered much of the ground when it said that "to be a successful teacher of mechanical drafting one must first have been a commercial draftsman." Carry this

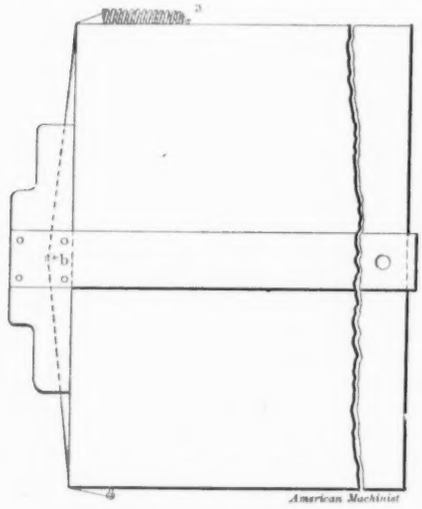
a little farther. Let it apply to the whole school, and let no one teach who has not a good commercial record behind him. Throw out the young student-professors into the maelstrom of business life to get experience. Make the pay of the professor and teacher the equal of that earned by men of their grade in commercial life, and thus attract men eminent alike for their technical knowledge and their practical knowledge of what is wanted in the world of business, and what is the requisite of success. Then, and not till then, will the incongruities of our technical education disappear. ENGINEER.

Drawing Board Attachment.

Editor American Machinist:

The sketch shows a simple yet useful attachment for a drawing board which I noticed in our drafting room. Although this idea may not be original, still someone may profit by it.

Attach a spring *a* to the top of the drawing board, then attach a piece of strong twine to the opposite end of spring; next pass it around both corners of the board,



DRAWING-BOARD ATTACHMENT.

having it perfectly tight, and fasten at the lower edge by means of a screw eye. Put a round-head screw *b* in the under side of the T-square head and insert twine in rear of the screw; the tension of the spring will then hold the head of the square against the edge of the board *c*, and many mistakes will be prevented, as the T-square is always true.

EDWARD W. MONAHAN.

Halving Fractions.

Editor American Machinist:

Referring to the article "Subtracting Fractions," at page 1555, I may say that I have used a method of halving fractions which saves worry and time. Suppose we wanted to halve $9\frac{23}{32}$ inches. Most draftsmen, I note, would say $4\frac{32}{64} + \frac{23}{64} = 4\frac{55}{64}$ inches. The simple way is to add the numerator and denominator together and place the sum over the next highest denominator, and for the integral subtract 1 from the given number and halve the remainder. Thus in $9\frac{23}{32}$, adding $\frac{23}{32}$, placing that over the next highest denominator, which next to 32 is 64 $= \frac{55}{64}$. Taking 1 from 9 and halving $= 4$, then half of $9\frac{23}{32} = 4\frac{55}{64}$ inches. The rule applies to all fractions whose whole number is an odd one. If the number is unity, the operation is then of the simple form: Half of $1\frac{7}{16} = 1\frac{7}{23} = \frac{23}{32}$ inches. Those who use this cannot help saying it is very simple and a great time saver. It is not my own, and a draftsman I knew seventeen years ago said he had used it for twenty-five years.

Something else he showed me, although it does not enter into mathematical computations, is to arrange the 10 digits to equal 100. As it is ingenious I here give it:

$$\begin{array}{r} 49\ \frac{1}{2} \\ 50\ \frac{1}{2} \\ \hline 100 \end{array}$$

It will be noticed that all are used and each only once. PINKNEY.

Casting Pipe Direct From the Blast Furnace.

Editor American Machinist:

At a certain foundry in the Midlands large government orders were executed for pipe. Periodically the inspector would visit them for purposes of inspection. According to specification the pipes should have been cast at the second melting, or, in other words, from the cupola. However, seeing that it cost money to run the cupola, it was customary to cast them direct from the blast furnace. It must be understood that these pipes are molded vertically (socket down) on what are termed pipe pits, excavations of circular form. The flasks are hinged, one half being fixed to the walls of the pits, the top reaching almost level with the top of the walls. Runners are formed from the tops of the molds, leading into one main runner which runs to the furnace. At each pipe is fixed a gate formed of a plate covered with loam and dried. The furnace is tapped and the molten metal runs into the main runner and flows to the pipes, to cast which the loam-covered gates are raised, each in turn, and, after casting, replaced. One day, while casting in this wise, word was passed around that the inspector was about. Immediately the furnace was "bottled up," the last gate used was closed, and while metal was being brought from the cupola as a blind, the main runner was covered up with sand. The inspector arrived on the scene and, after looking on a minute or two, made right for the covered-over conduit. Seeing this, an old hand walked behind him, watching his every footstep and ready to stay his progress if he ventured too near the "danger trap." As it happened, he stepped right over, thus unconsciously saving the reputation of the firm.

Talking the other day with a foundry expert, he made the statement that the plan of casting direct from the blast furnace—except for pig iron—had entirely died out, as the metal was found to be unreliable for work where strength was a consideration, and nowadays engineers went in for cutting down weights so fine that such practice would be deemed unsafe. Now, I know for a fact that to-day at least one blast furnace is in constant use for casting pipes and structural ironwork. It is only used for making pig iron on Sundays.

In former days, in specifications it was the custom to give the thickness of pipes, with no reference to their ultimate weights, and the inspector tested them by their caliber and outside measure at each end. To outwit this, it was customary for the founders to make the core boards rounding in their length, so that the core would be struck up thinner in the middle. Their hash, however, was settled when the inspector brought with him a round ball, which had to be passed through every pipe. To-day, of course, even this is unnecessary, as they are bound to get them to a given weight with an allowance of only 2 per cent. on each side.

FRANCIS W. SHAW.

The Metric System From the Commercial Standpoint.

BY F. E. DRAKE.

In reference to the agitation concerning the metric system and the bill now before Congress authorizing its legal adoption in the United States, it may be possible that the experience of the writer during the past three years may be of interest in connection with this interesting subject.

I shall not attempt to discuss the scientific or technical values of either the metric or so-called "English" system, but will simply refer to the practical and commercial side of the question.

Having had the responsibility of selecting, preparing and installing the machinery and electrical exhibit of the United States at the Paris Exposition, a very intimate contact with mechanical and engineering usage in the principal countries of Europe was experienced. Aside from the English and United States manufacturers, the metric system was in universal use, and all catalogs, descriptions and technical data on manufactures of the various principal countries were expressed in metric equivalents; there may possibly have been a few rare exceptions where the purchaser aspired to British markets, when both metric and English equivalents were named.

As vice-president of one of the important class juries covering machine tools, the writer discovered that every representative of foreign governments on this jury preferred and best understood the metric system, with, of course, the exception of the English member.

During this Exposition, when all nations were gathered together, and where the

foreigners were examining with great interest the products of the United States, there were many expressions of regret that the American manufacturers in almost every case refused or failed to give, in their printed matter and descriptions, the metric equivalents, many times to the great detriment of their business relations, because of the inability of the foreign engineer and buyer to convert rapidly and mentally our system into the more familiar one. Since the Exposition, it has been the writer's privilege to carry out a reorganization of one of the largest and most modern shops in Germany, where the designing engineers work equally well in both systems, and where a considerable proportion of shop drawings are in feet and inches owing to the adoption (under license) of United States models. This shop also possesses a complete set of standards for both United States and Whitworth threads.

From a practical standpoint there can be no doubt whatever that the workmen and machinists prefer to work to the metric system, but whenever the same workmen have received shop drawings in feet and inches, there has been no objection on their part, and never any increase in their piece-work prices.

In the drafting room there were several draftsmen who had gained their experience in American shops, but who, after a short time, actually preferred to do designing work after the metric system—whether for the reason that they had grown into the habit of calculating according to the current usage of the country, or because of greater care and necessity for checking computations in English fractions, I know not—the practical result from a business man's standpoint being that we could design and construct according to the necessities of the purchaser, either after the English or metric system, with equal facility and equal results.

As to the expense involved in preparing for manufacture after the metric system, I might state that during a single year a complete new equipment of United States standards, gages, taps and dies, etc., were purchased without seriously affecting the general expense account. There never was any confusion, as the management insisted upon the use of either of the two systems in conformity with the wishes of the purchaser, and this ability on the part of the company to meet the buyer's requirements often secured orders which otherwise would have gone to the competitor. We can safely assume as true that what occurred in a German shop in reference to design and construction after the English system would be the same or essentially so when reversed.

An intimate contact with foreign conditions of manufacture may excuse the writer for the following criticism of our home methods. We know our strength and virility in machine designing and manufacturing and are inclined to be too supercilious in respect to our foreign trade. Instead of forcing the purchaser to accept the standard which is easiest for us, it would appear far more commercial and business-like for us to meet him at least half way and furnish him with what he wants, so long as he will pay for it, and is convinced that a machine designed and constructed after the metric system is more acceptable than the other.

The moment our present domestic demands decrease so that we have a reasonable excess of product we will be searching for the outside markets, and since engineering daily takes on a more international character, the wide-awake manufacturer will prepare himself little by little and at the least gross expense to meet the requirements of international trade.

Neglecting English manufacturers, it is quite certain that no antagonist of the metric system can produce as evidence a catalog of manufactured products in engineering lines which does not follow the metric system. Looking at the financial results, can we always afford to force upon a man a sack coat when he wants a frock?

H. B. Bartlett on the Metric System.

Following our plan of securing evidence regarding the comparative merits of the metric system from those who have had opportunities for using both the English and the metric systems in the process of machine construction, we asked the opinion of Mr. H. B. Bartlett, who spent many years in American workshops and finally was in a position of responsibility in the Small Tool Department of the Pratt & Whitney Company, from where he went to Berlin and for four years was superintendent of the Small Tool Department of Ldw. Loewe & Co. In that works they manufacture small tools for both the English and Continental tmarkets, and consequently use both systems of measurement on work where measurements are the most important thing and convenience of making measurements scarcely less so. Under date of October 18, Mr. Bartlett writes as follows:

"I am strongly in favor of the metric system being adopted in our country, but discussion over the pros and cons can last longer than that on the resumption of specie payment, and I think Horace Greeley's advice on the latter would apply very well in the present case. I don't believe in ridicule or even humor as an argument, but when that becomes necessary think the opponents of the English standard have the best of it on their side.

"It seems to me that the Irishman who, given a two-foot rule with which to measure a piece of timber and reporting it being 'as long as that stick ye gi' me, two bricks and the width o' me hand barin' me thumb' was getting back pretty close to the origin of our present standard or laying an equally good foundation for a new one. My five years' experience with the metric system here has increased my liking for it, which was pretty well fixed nearly twenty years ago, after about two years' experience as a toolmaker in a New England factory, where it was the exclusive standard. This factory afterwards went back to the inch, but with decimal subdivisions—a sort of involuntary compliment to the former system. I, however, prefer the millimeter as a unit to the inch in shop measurements in the construction of machinery. There is no special difficulty in learning it, and one soon becomes accustomed to thinking in millimeters without translating into inches in order to form an idea of their value.

"My experience has been only with the millimeter as a base unit, but I have talked with many American mechanics here with experience on bridge and shipbuilding work who are unanimous in favor of the metric standard. One especially, an electrical engineer, said: 'I don't see how we ever got along without it, and my only regret at having to return to the States is the English standard of measurement that I shall have to take up again.'

"I don't think the question as to whether the workman prefers to work to the inch or not is of any importance. In the average machine shop all he has to know is how to count and what and that will most likely be millimeters, and not centimeters or decimeters.

"The draftsman is the man who will have the most to do with the difficulties in learning it, and to the average one it would be recreation of a pleasant kind. But I think the majority could drop one and take up the other at once with no trouble whatever."

The Largest Wood Pulley.

What is claimed to be the largest all-wood pulley ever made is one recently built by the Reeves Pulley Company, Columbus, Ind., for the Taunton-New Bedford Copper Company, New Bedford, Mass. The pulley is 20 feet in diameter, 30 inches face and 18 inches bore. It was completed in twenty days after the receipt of the order.

A Gentleman Machinist.

According to an Omaha correspondent of the Chicago *Tribune*, D. H. Hoffman, a Union Pacific machinist getting $3 a day, has received the palm as the most expensively dressed man in that city. The extent of his wardrobe was brought to light in a trial in Omaha, where a man was charged with stealing a suit case full of clothing from him. While under oath he stated that the grip contained $6 worth of neckties. "How many neckties have you altogether?" asked the attorney. He replied: "I have $400 worth of neckties." The court gasped and the attorney turned pale. "Is the rest of your wardrobe in proportion?" asked the attorney. "It is," responded the witness. Hoffman was dressed faultlessly.

AMERICAN MACHINIST

Issued every Thursday by the

Hill Publishing Company

World Building, New York.

Also published at 34 Norfolk St., Strand, London, W. C.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$4 per year, postage prepaid, to any post office in North America, $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by newsdealers generally.

European subscriptions served by the AMERICAN MACHINIST CO., LTD., 34 Norfolk St., Strand, London, W. C.

Entered at New York P. O. as mail matter of the second class.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *16,500 copies are printed. Total for 1902, 965,200 copies. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

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A Merry Christmas to All.

It is twelve years now since the vagaries of the almanac, which is not constructed upon the metric system, permitted us to greet our readers with an issue on Christmas Day. The opportunity which the present year brings around is most opportune. Perhaps at no time in the past dozen years, if ever before that, could we have formulated the congratulations and the good wishes of the season with fuller justification of the former or with better hopes of the large fruition of the latter. We have been abundantly prospered in all our activities of late, and we have seldom looked out on a more promising future. Prosperity is becoming chronic. Some, of course, are to be found who are disposed to look on the condition as abnormal, and to keep an anxious eye constantly on the lookout for a great tumbling of the edifice of our hopes. We are not in sympathy with them. As we write we are very sure of two—or shall we not say two and a half?—of the three particulars upon which to base our hearty Christmas greeting. We have been genuinely and thoroughly prosperous throughout the past year, we are prosperous now, and there is promise of undiminished prosperity as far as we can see into the future. Were we ever in a better condition for mutual all-around expressions of kindly feeling and stimulating words of cheer?

The synonym for prosperity is simply business activity; all other things which prosperity implies automatically accompany the activity. The instinct of the race is industrious and its happiness lies in doing. Everybody who is anybody is now doing something, and is happy in the fact. Of course we work always for our reward with the joy of toil thrown in. Never can we be so sure of our reward as when we are all employed, which is now if ever. The activity of the present time is not in any one line or in any few lines of occupation, but practically in all, and especially in those most diverse. The continued profitable activity of the farmer is as pronounced as that of the mechanic, and herein lies our strength and our confidence. We are more largely than has heretofore been normal the customers or employers of each other. The conditions are such as to largely render the lessons of the past inapplicable. We have no occasion to be drifting soon again into days of comparative inactivity and unprosperity except by acts of egregious folly. We have "orders ahead" and that makes us all right. Not only has the manufacturer his orders ahead and the farmer his unfailing market, but the great American people has orders ahead and voluminous work before it, and it is for us to keep on doing it and drawing our pay. So now why shouldn't we, as rarely before, stop for a day which gives the occasion and rejoice over our achievements and our prospects and wish each other all around what the signs of the times seem so surely to guarantee? The AMERICAN MACHINIST simply does its share in wishing each of its readers and co-operators a Merry Christmas.

Mr. Drake on the Metric System.

We publish elsewhere in this issue an article by F. E. Drake on the metric system. Mr. Drake will be remembered as the man whose extraordinarily efficient management of the American machinery exhibit at Paris did so much to render that exhibit a success, and since that time until recently he has been engaged in special work in connection with electrical establishments in Europe, acting primarily in the interests of financial backers of such establishments. In this work he has been very successful, and only his preference for life in America has impelled him to come home. Mr. Drake's thorough Americanism cannot be doubted, nor can he be charged with lack of interest in or appreciation of American machinery building establishments, and therefore the impressions made upon him during his experience of the past five years ought to be worthy of very careful consideration by every American builder of machinery who wishes to approach the subject with an open mind and with a view to his own interests. We commend Mr. Drake's article to the careful attention of our readers, not because he takes a certain view or confirms any preconceived notions of our own, but because as a man who has his eyes wide open, is thoroughly competent and thoroughly loyal he has been through an experience peculiarly qualifying him to give the most valuable testimony.

Bound to be Misunderstood.

We are constantly finding fun in unexpected quarters, and our esteemed contemporary, the *Electrical World and Engineer*, is especially funny in its treatment of the metric discussion at the recent meeting of the American Society of Mechanical Engineers. Not funny all by itself, but certainly very funny when what it says is taken in connection with what was said and done at the meeting. Our contemporary has somehow arrived at the conclusion that the society placed itself "on record as openly opposed to the metric system," and on this assumption we are given much about the "rule-of-thumb contingent," "fanatical domination," "pained astonishment," "senile fanaticism," "futile rancor and general imbecility," "wilful and deplorable ignorance of the rule-of-thumb contingent as to the real provisions of the metric bill," etc., etc.

Now it happens that there were those at the meeting who seemed to be very much afraid that because the society had *refused* to condemn the metric system or the bill now before Congress its action would be misunderstood as an endorsement of said system and bill, and here we have before us a complete misunderstand-

ing based upon the entirely mistaken notion that the society did condemn the metric system and the bill, though by "a trivial majority of a rather lean meeting." The incident shows again the undoubted truth that societies (and individuals, for that matter) who try to do anything will be by some misunderstood, and it can't be helped.

Our Mr. Halsey, as a result of his participation in the meeting of the Civic Federation, at which he advocated his Premium Plan of paying wages, was referred to in the public press as a "prominent labor leader" and was quoted as having declared that the "Premium Plan is an invention of the devil."

These latter were, however, mistakes of the daily newspaper reporter, and are in a measure understandable. Our contemporary will discover in due time that the A. S. M. E. did not go on record as opposed to the metric system, and that as a result of the discussion a committee was appointed which has the preparation of the matter in hand for a vote upon it by the members, which committee is composed of three men, two of whom in the meeting opposed the view taken by the chief opponent of the metric system; the third man being understood to be opposed to the metric system and the proposed bill, though he took no part in the discussion of the question at the meeting.

Information About Grinding.

The development of the process of grinding as a means of finishing parts of machines is probably one of the most important things now before machine shops. We asked a well-known grinding and grinding-machine expert to write us a series of articles on the subject. He wrote one article, and said it would be easier for him to answer questions. He therefore (in a rash moment, perhaps) promised to try to answer any question that might be sent him that pertains to grinding, *i. e.*, such grinding as is done in finishing parts of machines. We therefore invite anyone, machine operator, foreman, superintendent, whoever wants information about grinding, or is in trouble with it, to send in an account and to ask questions. Our expert does not pretend to know all there is to be known about the subject, and in fact frankly confesses that he expects to learn some things himself from the correspondence, but we believe that very few men know more about the subject than he does. He will answer if he can, and, if he cannot, will frankly say so.

Welding with Acetylene and Ether.

The "Company of Dissolved Acetylene" has, according to the *Revue Industrielle*, Paris, been experimenting with a blowpipe or burner for welding metals by acetylene. One of the chief difficulties encountered has been to regulate the proportions of oxygen and acetylene; for, according to the relative quantities of these gases, an oxidizing or reducing effect is produced. It is announced that experiments with a mixture of acetylene and ether vapor have been successful. The acetylene is made to absorb vapor from the ether, thus obviating cocks to regulate the supply of each gas. A green flame, as small as a pencil point is produced. The statement is made that the heat obtained exceeds that of the electric arc, which may be doubted. But at any rate, this flame is said to be unsuited for optical projection instruments, since it quickly melts even refractory substances. It makes a hole in a bar of iron in a few seconds. It is easy to perceive that iron plates may by this process be welded in a minute. First a file is passed over the edges to be joined; then you weld a point at the middle and two others at the ends of the line of contact, and finally pass the flame along this line. With thick plates the edges are filed in a particular shape and then a bar of iron melted by the flame is passed along them to act like solder. The new method is successful with wrought iron and steel, but not thus far with cast iron.

Meaning of the Action of the A. S. M. E. on the Metric Question.

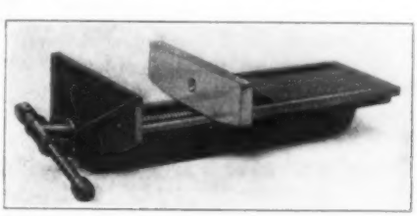
We have received the following communication from Gus. C. Henning, of New York:

"It is with great pleasure that I read your straightforward and correct editorial about the proceedings at the annual meeting of the American Society of Mechanical Engineers, and the precision with which you record what the society has heretofore done in relation to the metric system. What you have published is almost word for word what I have repeatedly emphasized at the meetings, and I trust that members will read your words carefully and remember them. Would that all technical journals reported meetings of engineering societies in a similarly unvarnished and complete manner! Thanking you for the important stand you have always taken and again maintain."

Some New Things.

A PATTERNMAKER'S VISE.

We illustrate herewith a new vise for patternmakers and woodworkers. The jaws are 12 inches wide, 3½ inches deep



A PATTERNMAKER'S VISE.

and the vise jaws 16 inches. The screw works through a solid bronze nut for all the movement. There is a loose, swiveling jaw that drops in between the jaws by means of which a piece can be clamped that has angles on it two ways. These vises are made by J. L. Gard, Denver, Colo., who is a well-known contributor to our columns on patternmaking subjects, and says he used the vise for several years in his own shop with satisfaction.

VERTICAL SPINDLE DISK GRINDER.

The half-tone illustrates a vertical spindle disk grinder recently put on the market by the George Gorton Machine Company, of Racine, Wis. The spindle of this

VERTICAL SPINDLE DISK GRINDER.

machine is of hard tool steel ground to size; it is 1¼ inches in diameter and carries an 18-inch disk. The driving pulley is placed near the lower end of the spindle, the base of the machine having a square opening at the back to admit the driving belt. The idler pulleys are carried by a bracket which may be adjusted on the upright to keep the belt tight. The pulleys are oiled from the center of the shaft upon which they are mounted. The table, which is adjustable by means of a screw, is provided with an adjustable fence or gage, and arranged to carry an improved dust shield. This machine is especially adapted to the grinding of flat surfaces or small pieces, and is equipped, when so ordered, with a semi-automatic fixture for rapidly handling such parts as chain links, cutter disks, etc., which are to be finished in large quantities. The machine is equipped with countershaft, wrenches, cementing press, etc., and weighs 1,000 pounds.

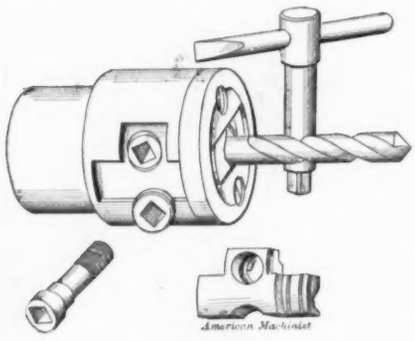
THE "IDEAL" SOFT HAMMER.

F. L. Montgomery, 34 Park Row, New York city, is making a soft hammer which he claims completely fills the place of the copper hammer at less than half the original cost or the cost of replacement. He has experimented until he claims to have found an alloy as hard and tenacious as copper. It is cast on a handle of iron pipe, and it is claimed will never become loose. When a hammer needs to be re-

newed it will be exchanged with a liberal allowance for the old material by weight. The hammer is made in four sizes.

NEW CHUCK.

The cut shows a drill chuck recently put on the market by the Westcott Chuck Company, Oneida, N. Y. This chuck, which is known as the "Little Giant Auxiliary Screw Chuck," has, in addition to the regular right- and left-hand screw for operating the jaws, an auxiliary screw by



DRILL CHUCK.

means of which the jaws are firmly tied together after they are tightened on the work. This screw and one of the jaws are clearly shown in the cut. The jaw is drilled and counterbored, as indicated, for the body and head of the screw, the opposite jaw being tapped to receive the threaded end of the screw. By tightening this screw, after the jaws have been set up on the drill in the usual way, the drill will be held tight, as there is no chance for the jaws to spring open at either side. The chucks are made in several sizes; for holding drills or stock above 1½ inches in diameter they are made with straight bodies arranged to be fitted with face-plates.

Technical Publications.

"The Civil Engineer's Pocket Book." By John C. Trautwine, revised by John C. Trautwine, Jr., and John C. Trautwine, 3d. Eighteenth Edition. 1,079 4x6¾-inch pages, with numerous illustrations. Price, $5.00.

This is one of those publications of which praise is superfluous. The present edition has been more extensively revised than any former edition, 370 pages being new, while the total number of pages has been increased by about 100. It is impossible to give even a list of the revisions and additions. We may, however, note that the sections on Statics on Beams and on Trusses have been almost entirely rewritten and modernized. The revisions have been so extensive as to make it necessary to rearrange and repage the book so that the familiar numbered and lettered pages, which accompany minor additions, have disappeared. While intended primarily for civil engineers, the older editions have been found to be of almost equal service to mechanical engineers, and this will also be found to be the case with the present edition. No notice of the book would be complete which did not mention its splendid index. This occupies forty pages and, what is more to the point, it is well made and avoids the exasperating hunts after the thing wanted, which are the too common experience of pocket-book users. The paper, printing and binding are up to the standard of former editions, although the flap of the cover, which, we suppose, was the original reason for the name "pocket book," has disappeared. The original edition appeared thirty years ago, and no greater service to engineers has ever been rendered than that which the book as it stands represents and embodies.

The French chargé d'affaires at Berlin announces that measures are in progress for the formation of a trust among German electric manufacturing concerns. The capital of the combination, if it should go through, would be about 350,000,000 marks —$87,500,000.

The Mansfield Technical Society, of Mansfield, Ohio, has been organized among the officers and employees of the Ohio Brass Company, of that city. The object of the society is the promotion of technical knowledge among its members. The regular meetings of the society are held on every third Tuesday, at which time papers pertaining to various branches of technical work are read and discussed. A reading and reference library has been established in connection with the society, and a number of technical papers, trade journals, etc., are kept on file for the use of the members.

The *Engineering Magazine* in its December issue, refers to our anniversary number as follows:

"Our interesting contemporary, the AMERICAN MACHINIST, having reached its twenty-fifth birthday, very properly celebrates that event by the issue of an anniversary number, and in it appears a number of articles by men who have been identified with the growth of mechanical engineering during that period. The limitations of space will not permit more than a passing glance at some of these contributions, but some quotations may serve to show how the development of the period looks to men who have not only seen it, but have in great measure been instrumental in bringing its changes to pass."

Then, after quoting at length from the articles of Professor Thurston, Rear Admiral Melville and Mr. Booth, our esteemed contemporary remarks:

"The entire number is a most interesting review of the work of the individual from whom our valued contemporary takes its name, a record of the work of the machinist in the United States of America."

Personal.

Beecher Ogden, who was formerly advertising manager of the International Correspondence Schools, is now connected with the advertising department of the H. W. Johns-Manville Company, 100 William street, New York.

Obituary.

Thomas Skelly, a bolt manufacturer, died in Philadelphia, December 20, seventy-two years old. He was born in Dublin, coming to Philadelphia when a boy. He was one of the largest owners of real estate in West Philadelphia.

Commercial Review.

NEW YORK, Monday, December 22.

Recently we had an interview with the leading salesman of a well-known machinery house, and his experience during the present month so well expresses the current condition of trade in machinery circles that we append the salient portions of it:

"From seven different sources during this month, I learned of some orders being possible. I went to those who had charge of placing them, and found that my information was correct. In every case I had the good fortune to be given an audience, and in four cases was told that my representations were entirely satisfactory. The net results of my labors in all of the cases was to be informed that the orders would not be given out until January. Now this kind of an experience is not mine alone, but of many salesmen with whom I have exchanged comments on the condition of business. Unless all signs fail, it seems to me that the new year will open under extremely favorable auspices in the machinery trade, and that the prospects of continued activity in it during the new year are of the best."

A machinery merchant with whom we conversed spoke in a similar strain, but added a little originality to his remarks by saying:

"It's the most difficult thing imaginable to get people to give you an order this month. Even where they tell you they are in the market for a machine tool and you offer it to them for $400, and they know it to be well worth $500, still they'll tell you to come around the early part of next month."

Another development of the month which has been called to our attention by several machinery houses is that collections have been poorer this month than at any time this year. The scarcity of money has not only made itself felt in Wall Street, where extraordinary plans were recently formed to relieve it, but in many industrial establishments affiliated with the iron and steel industry. We know of one concern which was so seriously handicapped in consequence of it that an immediate brief suspension of operations was

under advisement. All danger from this source has since been removed. Anent the unfavorable money situation, all reports are to the effect that an early return to normal conditions can be counted upon for a certainty.

Steel plate manufacturers held a meeting on last Thursday at the Waldorf-Astoria, this city, and discussed the question of prices. After a very animated discussion, it was decided to continue in force the mill agreements which exist now.

Perhaps in no branch of the iron and steel industry is prosperity more perceptible than in the steel-plate trade. As we stated in our last issue, the orders far exceed the producing capacity, and material is so scarce that those possessing it can name any price they please. There are some mills which refuse to take any orders now, stating that those they have already booked represent their maximum capacity for next year, while a few mills have orders which cannot be filled before 1904, an almost incredible statement.

The 4,000 employees of the Crane Company, Chicago, Ill., manufacturers of fittings, etc., were made happy during the week by the announcement that they would receive 5 per cent. of their annual wages as a Christmas present. Some idea of the company's generosity may be gained when it is said that its act will imply an outlay of about $135,000.

Several years ago an effort was made to form a combination of the emery-wheel manufacturers of the country, but it fell through chiefly because the smaller concerns were averse to entering it.

We understand now that the project is again under consideration, with the Safety Emery Wheel Company, of Springfield, Ohio, either taking an active part in promoting it or in being strongly induced to do so. It is claimed that there are about thirty plants in the United States, which have an aggregate output of about $2,500,000 annually.

Recently the National Abrasive Association held a meeting in Buffalo, and discussed terms and standard list prices, but definite action was deferred on both matters until the association meets next June at Niagara Falls, by which time, it is expected, a better insight into the outlook for trade will be possible than at present.

When the "Morgan Shipping Combine" was completed, considerable gossip was heard relative to the changes it would make in ocean freights, if any. We are authoritatively informed that, while there is a possibility of some changes being made, the company has not the remotest idea at present of changing the rates on iron and steel products. Importers of iron will be particularly interested in this announcement, as it will enable them to purchase their iron abroad, particularly for forward delivery, with some definite idea of the part transportation will play in the matter. The company's proposed policy is also of interest to both importers and exporters of machinery, in the handling of their freight.

The New York Central Railroad is making extensive improvements to its electrical plant at Weehawken, N. J., and has given some good orders to the General Electric Company and Westinghouse, Church, Kerr & Co. for steam engines and electric alternating current generators, footing well up in the five figures.

The Prentiss Tool & Supply Company have just opened a large store on the corner of Oliver and Purchase streets, Boston, right in the heart of the machinery district, and have put in quite a large stock of tools, among the lot being fifteen different types of power presses made by Perkins Machine Co., South Boston, Mass.

The Abendroth & Root Manufacturing Company, whose local offices are at No. 99 John street, announces that its plant at Newburgh, N. Y., has been equipped with modern machine-shop and foundry appliances, and that it is able to take orders for machine-shop work, particularly for special machinery and tools.

The Western Electric Company, of Chicago, Ill., reports very gratifying results from its Constant Potential Alternating arc lamp. This lamp operates on the repulsion principle, and the favor with which central station managers have received this lamp, as well as the fact that a competing manufacturer has recently copied the details of its mechanism, are tributes to its intrinsic worth. The company will be pleased to quote attractive prices to prospective buyers.

The Chicago Pneumatic Tool Company report the business outlook very promising for the month of December, 1902, and the sales show an astonishing increase over those of December, 1901. The following are a few of the concerns for whom they have installed pneumatic machinery during the past week: Townsend & Downey Ship & Engine Company, New York; Ross Iron Works, Brooklyn; Wm. Cramp Ship & Engine Company, Philadelphia; American Locomotive Company, Schenectady Works, Schenectady, N. Y.; Shapley & Wells, Binghamton, N. Y.; Boston Bridge Works, E. Cambridge, Mass.; Kensington Shipyard, Philadelphia; Ricard Boiler & Engine Works, Toledo, Ohio; C. E. Rogers Granite Works, Sembury, Mass.; Baldwin Locomotive Works, Philadelphia; Rogers Locomotive Works, Paterson, N. J.; Louisville & Nashville Railway, New Decatur, Ala.; Lake Erie & Western Railway, Lima, Ohio.

The Cleveland Punch & Shear Works Company secured an order this week from the Great Lakes Engineering Works for Cleveland tools to be installed in their new plant at Detroit, Mich. The contract calls for twenty-eight machines, consisting of Cleveland punches, shears, rolls, plate planers, radial drills, etc. The amount of the order aggregates about $50,000, and is one of the largest contracts awarded this year in this line.

CHICAGO MACHINERY MARKET.

December will make a very fair showing in the volume of business transacted in engines and boilers. Early in November there was a brief season of respite from keen inquiry. It passed away and was followed by a demand that has kept representatives of makers fairly busy ever since. One reason for this continued activity is that buyers are not of the opinion that prices are destined to recede in the near future. In some of the crude metal products, like wire and nails, sheets, tin plate, pipe, etc., values have declined within the past two or three months and there have been some intimations of further losses to values. But tubes are strong and scarce, and plates are sold up to the third quarter of 1903. Concerning pig iron, there is not the same assurance of strength and some buyers anticipate a decline during the next six months. But the falling of prices for that commodity alone will not be sufficient to seriously affect the costs of power. There appears to be no hesitation in the position of buyers. Neither the fear that business will wane in the coming year nor the suggestion that prices may fall has any standing whatever in the present market for power, so far as it can be judged by the representatives of makers. The only adverse condition is the usual shading off of business that comes at this closing period of the year, when transactions are naturally limited to quick wants. Last December was an exception, business continuing excellent through the month. Trade this month may not be quite so active as a year ago, but it will from present indications exceed that of the preceding month.

A few large transactions have been closed and more are pending that may be closed before the month ends. Thus one large maker of boilers notes that he has sold two orders aggregating 6,000 horsepower for Western manufactories, the purchasers requesting that mention of the same be for the present withheld. Other transactions of similar character have been brought to a successful issue, the work of construction to be speedily begun. The Allis-Chalmers Company has just sold two 4,000 horse-power vertical compounds to the Brooklyn Rapid Transit Company and among its other recent orders are blowing engines for the Sheffield Iron & Steel Company, Sheffield, Ala.

The Frost Manufacturing Company has just shipped to Portland, Ore., ten carloads of boilers and engines for distribution in that territory. They have also sold thirty boilers for use in the Denver (Colo.) district. Dealers in boilers and engines appear to be stocking up and evidently look for a brisk trade next spring.

Quotations.

NEW YORK, Monday, December 22.

New York prices for Northern and Southern irons for the first half of 1903 are as follows:

Northern:

No. 1 X	$23 25 @ $24 75
No. 2 X	22 00 @ 22 75
No. 2 plain	21 00 @ 21 75

Southern:

No. 1 Foundry	23 25 @ 23 50
No. 2 Foundry	22 25 @ 22 50
No. 3 Foundry	21 50 @ 22 00
No. 4 Foundry	20 50 @ 21 50

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.95c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.30c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 11⅝ @ 11¾c.; electrolytic and casting, 11½ @ 11⅝c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 26 @ 26⅛c.

Pig Lead—4.10 @ 4.12½c., in 50-ton lots.

Spelter—4.87½ @ 5.00c.

Antimony—Cookson's, 8¼ @ 8⅞c.; Hallett's, 7⅛ @ 7½c.; other brands, 6¾ @ 7c.

Lard Oil—Prime City, 87 @ 90c., according to brand and quantity, ranging from one barrel up to large lots.

New Catalogs.

Robb Engineering Company, Ltd., Amherst, N. S. Steam boilers. 6x9, pp. 51, paper.

Stephens-Adamson Manufacturing Company, Aurora, Ill. Belt conveyors. 6x9, pp. 15, paper.

Austin Separator Company, Detroit, Mich. Catalog No. 12, "Austin" separators. 6x9, pp. 20, paper.

The Knecht Bros. Company, Cincinnati, Ohio. "Knecht" sensitive friction drill. 3x6, pp. 16, paper.

Baldwin Locomotive Works, Philadelphia, Pa. "Motor and Trailer Trucks," No. 38, pp. 35, 6x9, paper.

Fitchburg Steam Engine Company, Fitchburg, Mass. Steam engines and boilers. 6½x10, pp. 32, paper.

Frank Mossberg Company, Attleboro, Mass. 1903 catalog of wrenches and bells. 3½x6, pp. 20, paper.

Scully Iron & Steel Company, Chicago, Ill. Stock list for November and December, 1902. 4½x7, pp. 144, paper.

United States Gutta Percha Paint Company, Providence, R. I. Rice's finishes for machinery. 6x9, pp. 23, paper.

The Garvin Machine Company, Spring and Varick streets, New York. "A Modern Machine Shop Outfit." 6x9, pp. 56, cover.

The Brown-Cochran Company, Lorain, Ohio. Ice-making machinery, Brown gas engine, compressors. 4x7¼, pp. 12, paper.

American Mechanical Cashier Company, 40 Wall street, New York. The "Mechanical Cashier," described and illustrated. 6x8, pp. 21, decorated paper cover.

Rand Drill Company, 128 Broadway, New York. "Imperial" air compressors, describing in detail types Nos. 10 and 11; half-tone illustrations. 6x9, pp. 31, paper.

Ransom Manufacturing Company, Oshkosh, Wis. Catalog "F," showing the different types of "Vulcan" grinders, attachments, etc. 6x9, pp. 36, paper cover, in two colors.

Theo. Audel & Co., 63 Fifth avenue, New York. A booklet describing the "Engineer's Standard Library," a series of books by Hawkins on engineering, electricity, mechanical drawing, etc.

A. L. Ide & Sons, Springfield, Ill. "Ideal" steam engines; printed in two colors on coated paper; half-tone illustrations showing engines complete and parts in detail. 6x9, pp. 77, embossed paper cover.

Fort Wayne (Ind.) Electric Works. "Small Direct-Current Electric Motors, Type 'E,'" Bulletin No. 1036; "Enclosed Alternating Current Arc Lamps," No. 1027; "Electrostatic Ground Detectors," No. 1035.

Atlas Car & Manufacturing Company, Cleveland, Ohio. Catalogs No. 1008 and No. 1012, of cars for industrial railways, for use in brick yards, cement plants, mines, rolling mills, etc. 6x9, pp. 48 and 10, paper.

Whiting Foundry Equipment Company, Harvey, Ill. Electric traveling cranes, hoists, etc. Catalog No. 36. Detail and installation of cranes shown by numerous illustrations. Printed in two colors. 6x9, pp. 123, paper.

Wm. Gaertner & Co., 5347-5349 Lake avenue, Chicago, Ill. Interferometers and accessories. Circular No. 1, showing various types of this instrument, some of its applications, with directions for its use. 6x9, pp. 32, paper.

Wyman & Gordon, Worcester, Mass. Drop forgings. This catalog contains "A Short Story of Alfried Krupp," and is one of a series of biographies of prominent men in mechanics and engineering published by the above company.

The Chicago Flexible Shaft Company, Chicago, Ill. "Stewart" gas blast furnaces, flexible shafts, etc., showing different furnaces for different purposes and many applications of the flexible shaft; half-tone illustrations. 7¾x11, pp. 63, paper.

The Safety Car Heating & Lighting Company, 160 Broadway, New York. The "Pintsch" system of car and buoy lighting. An attractive catalog, printed in two colors; half-tone illustrations; coated paper; handsome cover design. 6x7¾, pp. 46, paper.

The Acme Machinery Company, Cleveland, Ohio. Bolt cutters, nut tappers, bolt heading, rivet heading, upsetting and forging machines, with detailed information on dies, die heads, etc.; illustrated. This is the largest catalog published as yet by the above company and covers a very complete line of belt-making machinery. 9¼x6, pp. 140, embossed paper cover.

The Jeffrey Manufacturing Company, Columbus, Ohio. Elevating and conveying machinery, chain belting and steel cable; illustrating and describing power-transmission machinery in various applications, necessary accessories and supplies. The catalog contains information of much value to those interested in labor-saving appliances for the transmission of power. 5½x7¾, pp. 372, paper.

Manufacturers.

J. H. Bass, Fort Wayne, Ind., will build a steel casting plant.

The Industrial Iron Company, Baltimore, Md., is enlarging its plant.

Fred E. Newell's brass foundry, Central Falls, R. I., will be enlarged.

The Wilmington (Del.) Malleable Iron Company will erect a new plant.

The new plant of the Shelby Steel Tube Company, at Greenville, Pa., is to be enlarged.

The Howard W. Middleton Company, Philadelphia, will make improvements at its foundry.

The Illinois Malleable Iron Company, Chicago, has been granted a foundry building permit.

So. Louis (Mo.) Malleable Castings Company has received a permit to erect a foundry building.

A $250,000 cotton mill will be erected at Lockhart Shoal by the Lockhart (S. C.) Mill Company.

Schroeder Bros., manufacturers of grain dumps, Minier, Ill., are building an 80x100-foot addition.

Plans have been approved for a five-story building for Vredenburg & Co., printers, Rochester, N. Y.

The Bailey & Blendinger Manufacturing Company, Woburn, Mass., contemplates enlarging its plant.

The Corbin Cabinet Lock Company, New Britain, Conn., will, it is said, build an addition to its plant.

The B. Buerkens Manufacturing Company, wagon maker, Pella, Ia., is building an addition to its factory.

A building permit has been issued to the Indianapolis (Ind.) Foundry Company for an addition to its plant.

The Jackson & Battle Creek Traction Company has bought land for car barns and repair shops near Albion, Mich.

The plant of the Elk Tanning Company, Ridgway, Pa., has been largely destroyed by fire, including machinery.

The Fostoria (O.) Glass Specialty Company has lost its factory by fire, but will rebuild there temporarily at least.

A cabinet and novelty factory to be known as the Johnson & Meredith Cabinet Works, is being built at Cadillac, Mich.

Plans have been filed for new shops, 110x534 feet, in Buffalo, N. Y., for the International Steam Pump Company.

The Peter Smith Heater Company, manufacturer of car heaters, will erect a factory in Detroit, Mich., in the near future.

It is proposed to build a new cotton mill at Saluria, Ala. T. C. Thompson and Brevard D. Miller, of Birmingham, are interested.

The Lang Canning & Preserving Company, Lincoln, Neb., will build a new factory, putting in its own gas plant and waterworks.

The plant of the Connecticut Saddlery & Bell Company, manufacturer of saddlery hardware, Meriden, Conn., has been gutted by fire.

Silberstein Brothers, Davenport, Ia., are erecting a factory for the manufacture of washing machines and eventually other articles.

The show-case factory of the Reid Manufacturing Company, Detroit, Mich., has been damaged by fire, some of the machinery suffering.

Caille Bros. Company, manufacturer of coin (slot) machines, Detroit, Mich., is planning to build a new factory, either there or elsewhere.

A spool and bobbin factory is to be established at Lestershire, N. Y., by the "Mawson" Spool Company, of Paterson, N. J., it is reported.

Under the auspices of the Board of Trade, Williamsport, Pa., a power transmission manufactory, to employ ultimately 100 men, will be located there.

A paper mill concern is negotiating to build a mill at Lafayette, Ind. Prominent among the local business men who are trying to secure it is W. W. Adler.

The Helmick Foundry & Machine Company, Fairmont, W. Va., manufacturer of mining

and other machinery and castings, is arranging to enlarge its plant.

The Anderson, Gas City and Middletown, Ind., plants of the American Tin Plate Company are to be removed to Elwood, Ind., early next year, it is reported.

The John Thomson Press Company will remove its plant from Hartford, Conn., to Long Island City, putting up a factory employing not less than 250 hands.

Th Northwestern Machine & Boiler Works, Duluth, Minn., proposes to build a plant, at a cost of $60,000, early in the spring. William Calliston is manager.

Smith & Wesson, manufacturers of revolvers, Springfield, Mass., are planning to build another factory in the spring, an addition to one now nearing completion.

The Kenyon Paper Company, Baldwinsville, N. Y., manufacturer of tissue paper, has increased its capitalization and is considering the enlargement of its plant.

It is proposed largely to increase the capital stock of the Buckeye Lumber Company, Spokane, Wash., and add a sash and a box factory to the plant at Hoch's Siding.

The Ruemell-Dawley Manufacturing Company, St. Louis, Mo., refrigerating machinery, power plants, etc., has received a permit for a factory building, to cost $15,000.

The capital stock of the New Castle (Pa.) Forge & Bolt Company has been increased from $75,000 to $300,000. New buildings are to be erected and machinery installed.

The Noble & Wood Machine Company's plant for the manufacture of paper and pulp mill machinery, Hoosick Falls, N. Y., is about completed, and is in partial operation.

The Northern King Thresher Works is a new shop being built at Marshalltown, Ia. Geo. B. Sellers and W. S. Montgomery are the men who will manufacture the thresher.

An addition is to be built to a plant of the American Linseed Oil Company, in Buffalo, N. Y., which will give the plant a capacity of 6,000,000 bushels of flaxseed a year.

A company has been incorporated in Maine to build a cotton compress at Memphis, Tenn. It includes W. A. Percy, C. F. Farnsworth, H. P. Johnson and other residents of Memphis.

It is stated from Toledo, O., that J. H. McCourt will erect a new building at the corner of Clarence avenue and Front street, Ironville, and will open a machine shop in the same.

The Hotaling-Warner Company, manufacturer of macaroni, Syracuse, N. Y., is contemplating the removal of its plant to Buffalo in the spring. The matter has not been definitely settled.

The Eaton, Cole & Burnham Company, brass and iron founder and finisher, Bridgeport, Conn., has in view a foundry addition in the near future, but the plans have not fully matured.

It is stated at Rockford, Ill., that George Mead has completed the formation of a paper mill company in Centralia, Mich., with a capital of $400,000. A plant will be erected as soon as possible.

George Briggs and R. E. Briggs, of Amesbury, Mass., and J. Elwood Cox, of High Point, N. C., propose organizing a company to establish a carriage-wheel factory at High Point, we understand.

Henry D. Atwood, of Taunton, Mass., desires to establish a plant at Fair Haven for the manufacture of retorts and crucibles, and has met the Committee on Growth of Town, of the Business Association.

The Jerseyville (Ill.) Industrial Association has made application for incorporation papers and proposes to erect a factory building for the use of a shoe manufacturing company that is to locate there.

The United States Gypsum Company, or "plaster trust," of Chicago and elsewhere, has been letting equipment contracts for a new plant to be built in Cleveland. It is proposed to establish new plants also in Toledo and Buffalo.

The Kay-Pim Manufacturing Company, 2300 North Broadway, St. Louis, will have their new plant in operation about the last of December, for the manufacture of all kinds of elevating, conveying and power-transmitting machinery.

James Godfrey Wilson is preparing to transfer his factory from Olean, N. Y., to Norfolk, Va., where it is expected he will employ 400 men by the end of the first year. He manufactures steel blinds, fireproof block floorings, etc.

The Brooklyn (N. Y.) Rapid Transit Company is transforming sheds at Thirty-ninth street and the bay into car shops. About $50,000 will be spent on the tools and fittings of the plant, in addition to the cost of transforming the buildings.

Preliminary work has begun toward a 2,500-barrel-a-day cement plant at Riverside, seven miles west of Cumberland, Md. Marion S. and Ernest R. Ackerman, of Plainfield, N. J., who control cement mill at Cumberland, are largely interested.

The Hendrick Manufacturing Company, Carbondale, Pa., manufacturer of perforated metals and oils, will build a new blacksmith shop. The Carbondale (Pa.) Machine Company, manufacturer of ice machines and filter presses, has in view to build a new plant.

From Port Arthur, Texas, it is stated that John W. Gates has organized a company, capitalized at $225,000, which will pave the main streets of the town, build an ice factory, dig a basin for small craft, 300x2,000 feet, and supply the town and refineries with fresh water.

The Toledo (O.) Steam Pump & Trap Company has secured two acres of land on Woodville street and will erect a plant for the manufacture of the Pitt rotary pump, of H. T. Fisher and J. W. Wigton, Denver, and a steam trap of Henry Moers and Albert Cook, of Toledo.

The Atlantic Macaroni Company will remove its works from Manhattan Borough, New York city, and Newark, N. J., to Long Island City (in Queens Borough, New York city). This concern uses patent machinery for drying, and will employ over 300 hands at the start.

The Coal Dealers' Supply Company, Binghamton, N. Y., has been fitting up a factory there to make such articles as adjustable screens, adjustable extension corrugated steel wagon chutes, short-turn coal wagons, baskets, etc. It is proposed to have a new building next season.

A new fertilizer company will be chartered at Montgomery, Ala. One of the incorporators is John W. Huger, until quite recently manager of the plant of the Virginia-Carolina Chemical Company at Memphis, Tenn. It is stated that the new company will have a plant at Montgomery.

The Board of Trade at Wayland, N. Y., has made arrangements with A. McCaig, J. Emig and J. A. Stillwagen, of Buffalo, and W. A. McFarland, of Lancaster, Pa., who have organized a stock company with a capital of $25,000, to manufacture drop forgings, motor supplies and a patent wrench.

The Keasbey & Mattison Company, manufacturer of magnesia pipe and boiler coverings and chemicals, at Ambler, Pa., has in view the establishment of a branch plant in the Milwaukee district, to employ, it is likely, 300 hands. The president of the company has already been in Milwaukee, looking for a site.

The N. & G. Taylor Company, Philadelphia, Pa., manufacturer of tin plate, which operates the "Independent" plant at Cumberland, Md., has leased a plant of the Maryland Sheet & Steel Company, at South Cumberland. The capacity of the steel mills will be increased, and open hearth furnaces and a bar mill added.

John W. and Eugene F. Vest who have long been engaged in business at Cloversport and Louisville, Ky., will establish a plant in Kansas City, Mo., for making pickles, mustard, grocery sundries and other pure food products. An office has been temporarily established in the Arlington Building. The new corporation will be known as the Vest Pure Food Company.

The Quaker Portland Cement Company is at the point of ordering all of the machinery and fittings for its new plant, with a capacity of 4,000 barrels per day, and is willing to consider any offers of second-hand machinery for the equipment of this new cement mill, including four marine type engines of 800 to 1,000 horse-power each. Communications should be addressed to 26 Broadway, New York.

The Hollow Spar & Boat Company, of Whitestone, L. I., N. Y., is erecting a plant for the manufacture of launches and yachts. It has incorporated with a capital stock of $200,000, and the directors are John G. Fraser, 195 Broadway, New York city; George R. Bidwell, 149 Broadway, New York city; John M. Dillon, Far Hills, N. J.; George S. Clay, Fairfield, N. J., and George Bullock, of Cincinnati.

The Pittsburg & Lake Erie Railroad has awarded the contract for building the superstructure of the new erecting and machine shop and power-house building at the McKees Rocks yards. In the machine shop there will be seventy-eight machine tools, each supplied with a variable speed electric motor. The cost of the entire new plant, with its various shops and equipment, is well in excess of $1,000,000.

The Cumberland Foundry & Machine Company, Nashville, Tenn., has been receiving bids for equipment for materially enlarging the capacity of the plant. The company will install a new 12-ton cupola, a track scale, a coke house and paint shop. The capacity of the plant has been doubled since it began business last June. The company manufactures hardware specialties, railroad castings and a patent ball-bearing corn-sheller.

The United States Electro-Pneumatic Corporation has been incorporated to manufacture a patent cash carrier system. It now has a plant at Lowell, Mass., but will move it to Woonsocket, R. I., where a larger one will be erected. It has established a temporary office in Woonsocket. The president is Judge Elmer J. Rathbun, of Providence; treasurer, Joseph W. Trinque, of Woonsocket; secretary, Albert Desrochers, of Woonsocket.

The Government of Japan offers a subsidy of half a million yen for more than four years for the location there of a modern glass plant like those in America. A bill to carry out this plan will be submitted to the Diet. A plan to establish glass works on a large scale has been undertaken by Baron Shibusawa, who has just returned from a trip to America and Europe. The plant will be built at Osaka, with a capital of a million yen.

The Inter-State Railway Company has been incorporated in New Jersey with a capital stock of $10,000,000. It proposes to control a chain of electric street railway lines in New Jersey, Pennsylvania, Delaware and

New York. The register office of the corporation will be at the New Jersey Corporation Company, at 419 Market street, Camden. One of the enterprises may be the building of a power plant at Reading, which will cost $1,000,000.

The Central Pipe & Valve Company, of Allegheny, Pa., has been reorganized under the name of the Central Pipe, Valve & Construction Company, with a capital of $100,000. Extensive improvements are to be made to the plant and considerable new machinery will be purchased. The present foundry is to be almost entirely rebuilt. As soon as the lease on the present property expires it is the intention to remove the plant to a larger and better site, where a pipe bending, pipe fitting and casting plant will be erected.

Work is about to be commenced near Bedford, O., on the erection of a plant to turn out structural iron work and machinery. The incorporators of the company, capitalized at $300,000, are Justin Griess, Jr.; C. A. Klump, Paul Schneider, Martin Mullen and I. W. Kallenback, all of Cleveland. The completed plans call for a structural shop, 160x600 feet; two machine shops, 120x400 feet; a forge shop, 120x400 feet; an erecting shop, 80x200 feet; a power-house, office building and half a dozen minor buildings.

The Delaware, Lackawanna & Western Railroad has completed plans for a big freight car plant in West Scranton, Pa., to cost about $550,000. There will be fifteen buildings. The contract for the power-house has been let. The wood-working mill will be 90x400 feet; blacksmith shop, 80x300 feet; machine shop, 80x180 feet. The plant will be run and lighted by electricity. The blacksmith shop will be equipped with the down draft forge system. Part of the machinery equipment will be transferred from an existing plant.

The Chicago Great Western is building at Oelwein, Ia., a 330-foot addition to the boiler and machine shop, which will make the building 1,030 feet long; a coach shop, 100x250 feet; a cabinet and upholstering shop, 50x100 feet; a blacksmith shop, 85x100 feet; a paint shop, 100x170 feet; an addition to the power-house, 25x60 feet. A battery of boilers capable of developing 1,200 horse-power will be installed, and a 600 horse-power engine will drive a 400-kilowatt generator. Orders have been given to expend $20,000 for new tools and machinery for the machine shops.

It is stated in Pittsburgh, Pa., that A. P. Bronson and David Llewellyn, formerly connected with the American Tinplate Company, have formed the Marietta Sheet & Tinplate Company, to build a tinplate plant at the Ohio town. The main building will be 120x300 feet. A 20-ton traveling crane will be installed and electric lighting plant, motors and engines. The furnaces will be furnished by Edward E. Erikson, Pittsburgh. The officers of the company are: M. F. Straus, president; Lakin C. Taylor, of Cambridge, O., secretary; A. P. Bronson, treasurer, and David Llewellyn, superintendent.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Grant. Gears. See upper corner, page 56.

Caliper cat. free. E. G. Smith, Columbia, Pa.

See the Lowe test indicator, page 67.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Working drawings for special machinery, patent articles, etc. Geo. M. Mayer, M. E., Monadnock, Chicago.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Practical manufacturing expert, designer of special tools, shop systems, etc. Eugene Wilson, AMERICAN MACHINIST.

An experienced engineer will perfect, simplify or improve upon articles of manufacture. Address Box 340, AMERICAN MACHINIST.

Export.—Engineer about to depart for Germany desires to secure representation of exporting firms. Address Box 345, AM. MACH.

Wanted—Heavy planer work, also machinery to build on order; low rates, quick service. Krom Machine Works, 10 Essex St., Jersey City.

If you have light model, experimental work or drawings you want done by experienced man and kept strictly confidential. Address Box 367, AMERICAN MACHINIST.

Wanted—A large contract to build medium or light automatic machinery; we have the plant, the experience, the capital; cam cutting a specialty; we make the best adjustable reamers. Ott. Mergenthaler Company, Baltimore, Md.

Liberal commission to machinery salesmen able to handle, as a side line, machines suitable for use by railroads, machine shops, saw and planing mills and by all manufacturers of wood and metal. Address Box 241, AMERICAN MACHINIST.

Purchaser for small manufacturing plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

The annual meeting of the stockholders of the Hill Publishing Company, for the election of five directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the office of the company, in the Pulitzer Building, 63 Park Row, in the city of New York, on the 12th day of January, 1903, at 12 o'clock noon. F. R. LOW, Secretary.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

Engineer wants position, erecting or installing machinery. Box 327, AM. MACH.

Draftsman, mechanical, college graduate, good detailer, seeks position. Box 374, A. M.

Graduate M. E., good designer, 9 years' experience, desires employment about January 1. Box 368, AMERICAN MACHINIST.

As foreman, by general machinist; temperate; age 30; engine shop preferred. Remington, 222 Thurber ave., Providence, R. I.

Draftsman, experienced in pump work, desires change; engines or air compressors preferred. Box 360, AMERICAN MACHINIST.

Experienced mechanical engineer wishes to invest, with services in executive position; best reference. Address Box 356, AM. M.

Situation as foreman, by man of 25 years' varied experience in machine business; have had charge. Box 372, AMER. MACHINIST.

Practical draftsman desires position with firm requiring designing, etc.; New York or vicinity. Box 334, AMERICAN MACHINIST.

Draftsman, mechanical, 5 years' experience in drawing room, 2 in shop, technical graduate, wants position. "Y., 123," AM. MACH.

Mechanical engineer, general work, desires position as assistant superintendent or chief draftsman. Box 359, AMERICAN MACHINIST.

Competent mechanic, designer and draftsman, wants position; 14 years' experience on special machinery, jigs and tools. Box 347, AMERICAN MACHINIST.

General foreman, responsible man, age 34, experienced in high-class automatic and interchangeable machinery, wishes to make change about January 1. Box 376, AMER. MACH.

As superintendent or foreman, by experienced man, expert on light interchangeable work, good designer and draftsman; Greater N. Y. or vicinity. Box 366, AMER. MACH.

A1 mechanic, 28, as foreman for tools, special machinery, molding machines, metal patterns and experimental work; temperate and steady. Address Box 369, AMER. MACHINIST.

Draftsman, designing, technical graduate, 2 years' shop and 4 years' drafting room experience, wants change; permanent position preferred; German and French languages. Box 358. AMERICAN MACHINIST.

Mechanical engineer, college graduate, chief draftsman and supervising engineer on power plants, excavating and coal-handling machinery, cranes, etc., will consider a change. Box 381, AMERICAN MACHINIST.

A thoroughly competent man of experience desires position as superintendent or foreman in machine shop; past 2 years as sup't in electrical line. Address "Superintendent," care AMERICAN MACHINIST.

A competent shop superintendent wishes a change; experienced in both manufacturing and building machinery; machine tools, gas engines, and air compressors. Address Box 361, AMERICAN MACHINIST.

First-class machine forger and tool dresser wants position with good, reliable firm; can handle men successfully; modern methods employed; best of references furnished. Address Box 377, AMERICAN MACHINIST.

Technical graduate, electrical engineering, 6 years manufacturing, practical and otherwise; analyzer and thinker; good executive; now in New York; salary $1,500; age 29. Box 378, AMERICAN MACHINIST.

A man with valuable experience in mill design and operation, steel, brass and copper, will correspond with any concern desiring the services of such a man; technical graduate. Address Box 337, AMERICAN MACHINIST.

Correspondence invited with firms manufacturing sugar machinery; would take charge of branch office in New York or establish same; am expert engineer and draftsman on sugar machinery. Box 344, AMER. MACHINIST.

Draftsman and assistant superintendent, 10 years' shop and drawing-room experience, technical, gas engine designer, wishes change; automobiles preferred; refer to present employers. Box 375, AMERICAN MACHINIST.

Technical graduate, 28 years of age, 3½ years devoted to practical general factory engineering, some experience in drafting, wishes change as draftsman; willing to start on very moderate salary. Box 371, AMER. MACH.

Wanted—By a young man, position as shipping clerk, assistant bookkeeper or general office assistant, including drafting; 10 years' experience; at present employed in machinery office; best references. Box 370, AM. MACH.

Mechanical Draftsman.—Young man of 4 years' experience in Texas land office, desires position as mechanical draftsman, tracer, colorer, etc., in a northern firm; best letters and references. Amos Wynne, 305½ East 9th st., Austin, Texas.

General foreman, 30, at liberty January 1; my knowledge is the result of actual shop practice of wide range, close observation of details and best methods as practiced by the successful ones; New York or Chicago vicinity. "Selkirk," care AMERICAN MACHINIST.

Mechanical engineer, college graduate, experienced designer of gas engines and gas power plants, general engineering and modern shop management, seeks position as superintendent, chief engineer or head draftsman. Address Box 341, AMERICAN MACHINIST.

Help Wanted.

Wanted—Good chemist for small gray iron foundry. Address Box 318, AMER. MACH.

Wanted—A first-class planer hand, used to planers 12x12x36 in. Apply to Morse Twist Drill & Machine Co., New Bedford, Mass.

Wanted—Machinist used to light machinery, sewing machines and repairs; give reference. Address "Newark," care AM. MACH.

Wanted—First-class machinists, in city near Philadelphia; steady work and good pay. The Reeves Engine Co., Trenton, N. J.

Wanted—A first-class patternmaker; one familiar both with wood and metal work and capable of handling men. Box 348, AM. M.

A few first-class mechanical and electrical engineers and draftsmen wanted; state experience and wages expected. Box 380, AM. M.

Wanted—Two or three draftsmen on miscellaneous work. State fully age, experience, salary, etc. Box 364, AMERICAN MACHINIST.

Wanted—Draftsman, experienced in printing machinery; state age, amount of experience, salary expected, etc. Box 604, Plainfield, N. J.

Wanted—A first-class toolmaker to take charge of tool department; one accustomed to

bicycle work. Address Day Mfg. Co., Lake View, N. Y.

Liberal commission to machinery salesmen to handle, as a side line, the Hartford Bench filing machine. Kinsey-Burt Co., 136 Liberty st., New York.

Foreman patternmaker wanted on valves and fittings; excellent opening for right man; state fully age and experience. V. M. C., care AMERICAN MACHINIST.

Wanted—Lathe hands and machinists; good wages and steady work to competent and reliable men; location near Albany. Box 355, AMERICAN MACHINIST.

Wanted—Machinists and draftsmen to send postal for free sample tables of lathe gearing and valuable formulas and tests. Box 290, AMERICAN MACHINIST.

Wanted—First-class, all-around toolmakers, capable of working from blueprints; steady position and good wages to right men. "B.," care AMERICAN MACHINIST.

Machinists—Send 5 cents in stamps for blueprint table of U. S. standard steam, gas and water pipe, giving tapping sizes. Address E. E. Meyer, Allegheny, Pa.

Wanted—Two or three first-class draftsmen, on general heavy mill and power-house design; give full particulars and salary. Box 365, AMERICAN MACHINIST.

Wanted—General machinists, to work principally on general job work; good wages and steady employment. Townsend Furnace & Machine Shop, Albany, N. Y.

Wanted—A bright, young, energetic lathe man, to take charge gang of small lathes. Address, giving age, references, salary, "Henderson," care AMERICAN MACHINIST.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

Wanted—First-class electroplater; must have thorough knowledge of all branches, including oxidizing and care of solutions. Answer Box 353, AMERICAN MACHINIST.

Wanted—First-class die sinker on drop forge work; steady employment to the right party; give age, experience and wages expected. Box 328, AMERICAN MACHINIST.

Wanted—An experienced mechanical draftsman for a permanent position with a rapidly growing company manufacturing paper machinery. Box 350, AMERICAN MACHINIST.

Wanted—A competent man, experienced in operating the Hartford automatic screw machine; give full particulars, age, references and salary desired. Box 363, AMER. MACH.

Wanted—Young man, good letterer, able to read drawings, to work on card index and records in drafting room; state age, experience, references, salary, etc. Box 352, AM. MACH.

Wanted—Ten first-class machinists on small, close work; good wages and steady work to competent and reliable men; no trouble. Apply to The Harris Automatic Press Co., Niles, Ohio.

Swedish-Americans wanted; several first-class locomotive erectors and locomotive boilermakers; apply, stating age, experience and wages expected. Address Vagn-och Maskinfabriks-Aktiebolaget, Falun, Sweden.

Wanted—Several good mechanical draftsmen; state age, experience, reference and salary expected; Americans preferred; permanent positions; 30 minutes from New York city. Box 351, AMERICAN MACHINIST.

Wanted—Foreman, responsible and experienced man to produce light interchangeable work; modern tools and shop; state fully experience and compensation wanted; references. Box 379, AMERICAN MACHINIST.

Wanted—First-class engineer and draftsman; technical graduate preferred; one with experience in water wheel, pulp and saw mill work; state age, experience and wages wanted. Address Box 362, AMERICAN MACHINIST.

Blacksmiths.—Wanted—Reliable man who thoroughly understands annealing, tempering and hardening tool steel and machine steel; steady position to first-class man. R. Hoe & Co., 2 Sheriff st., cor. Grand st., New York.

Wanted—Brass foundry foreman, understands up-to-date appliances; man experienced in the steam-fitting supplies preferred; in replying state where employed, married or single and wages expected. C. V. K., care AM. M.

We are constantly increasing the scope of our work, and invite application for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburg, Pa.

Wanted—Foreman; responsible and experienced man to produce light interchangeable work; shop is equipped with new and highest grade tools; just starting to manufacture; good chance for right man. Address Box 291, AMERICAN MACHINIST.

Wanted—By a manufacturing company in railway line located in the Middle West, employing 400 men, a thoroughly up-to-date foundry foreman who is progressive and capable of getting out work at the lowest possible cost. Address Box 349, AMERICAN MACHINIST.

Help Wanted.—Two first-class working foremen to take charge of departments in a factory making strictly first-class light machinery; watch-factory men preferred; give age, experience, references and wages expected. Address Box 354, AMER. MACHINIST.

Wanted—Brass foundry foreman, capable of turning out smooth, sound castings in composition, bronze and steam metal; molding machines and modern furnaces used (Piet's); must be a hustler and able to handle men; foundry located in a New England city. Box 346, AMERICAN MACHINIST.

Wanted—A good, experienced machine shop foreman, for shop connected with steel works and employing about 125 men; must be accustomed to handling men and turning out general machinery, including engine work; advise experience and salary expected. Address H. H. A., care AMERICAN MACHINIST.

Wanted—An experienced mechanic; one able to operate automatic machinery, design and build labor-saving machinery and to take charge of repair work in a nut and bolt plant; prefer young man with experience in this line; state age, experience and wages wanted by the month. Address Box 273, AM. M.

Wanted—A mechanical draftsman having had experience in gas engine work, by a manufacturing company in Michigan having an already well-established trade; a good opening for the right party; answer, giving age, experience, compensation expected and references, also send sample of drawing. Address Box 373, AMERICAN MACHINIST.

A large factory, located in the Middle West, manufacturing a full line of electrical apparatus and instruments, requires the services of a young man with toolroom and drafting-room experience, to design special tools, originate better methods, set premium rates, etc.; state experience, references and salary expected. Address Box 319, AMER. MACHINIST.

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Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cutting-off Machines
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Franklin Mach. Wks., Phila., Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Perkins Mach. Co., So. Boston Mass.
Wold & Co., Torris, Chicago, Ill.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Winkley Co., Hartford, Conn

Drawing Boards and Tables
Zacharias, E. M., Brooklyn, N. Y.

Drawing Instruments
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett & Co., Thos. H., Phila., Pa.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Q & C Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick Mach. Tool Co., Cincin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mueller Mach. Tool Co., Cincin., O.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reade Mchry. Co., Cleveland, O.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas. Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Christensen Engineering Co., Milwaukee, Wis.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
General Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Columbus Mach. Co., Columbus, O.
Cooper Mach. Co., Saltsburg, Pa.
Elyria Engine Co., Elyria, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
National Engine Co., Rockford, Ill.
New England Gas Engine Co., Boston, Mass.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gasoline Eng. Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Stover Engine Works, Freeport, Ill.
Struthers-Wells Co., Warren, Pa.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Chandler & Taylor Co., Indianapolis, Ind.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers-Wells Co., Warren, Pa.

Exhaust Fans
Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files, Letter
Derby Desk Co., New York.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.

Forges
Buffalo Forge Co., Buffalo, N. Y.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Wyman & Gordon, Worcester Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gas Furnaces
Am. Gas Furnace Co., N. Y. City.

Gear Cutting Machinery
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Dwight Slate Mch. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
Knell Air Brake Mfg. Co., Battle Creek, Mich.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. Y.
Lubriphite Co., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disc
Bayldon Mch. & Tool Co., Jersey City, N. J.
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Provi., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Falkenau-Sinclair Co., Phila., Pa.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., Prov., R. I.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co. Chicago, Ill.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Ohio.
Tanite Co., Stroudsburg, Pa.
Washburn Shops, Worcester Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Tanite Co., Stroudsburg, Pa.

Grindstones
Lombard & Co., Boston, Mass.

Gun Barrel Machinery
Rement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Works, Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Works, Buffalo, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Rement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Iroquois Machine Co., Providence, R. I.
Merrill Bros., Brooklyn, N. Y.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Q. & C. Co., Chicago, Ill.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Power
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Rement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Knell Air Brake Mfg. Co., Battle Creek, Mich.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Index, Cards
Derby Desk Co., New York.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Key Seaters
Baker Bros., Toledo O.
Bement, Miles & Co., New York.
Chattanooga Mchry Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Attachments
Bayldon Mach. & Tool Co., Jersey City, N. J.

Lathes
American Tool Wks. Co., Cin., O.
Auto. Mach. Co., Bridgeport, Ct.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry Co., Chicago, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Tanite Co., Stroudsburg, Pa.
Mich.
Washburn Shops, Worcester, Mass.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Eddystone Engineering Wks., Eddystone, Pa.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Wood
American Machinery Co., Grand Rapids, Mich.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lubriphite Co., Jersey City, N. J.
Lunkenheimer Co., Cincinnati, O.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Atlas Foundry & Mch. Co., Belleville, N. J.
Blanchard Mach. Co., The, Boston, Mass.
Fawcus Mch. Co., Pittsburgh, Pa.
Hoefer Mfg. Co., Freeport, Ill.
Knell Air Brake Mfg. Co., Battle Creek, Mich.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Lowe, H. A., Waltham, Mass.
McCrosky & Huber, Cincinnati, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Molds, Rimmer and Vise Jaw
Field, Chas. H., Providence, R. I.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Christensen Engr. Co., Milwaukee, Wis.
Crocker-Wheeler Co., Ampere, N.J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Nail Machinery, Wire
National Machy. Co., Tiffin, O.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.

Nut Tappers
See Bolt and Nut Machinery.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Oil Cups and Covers
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Packing, Steam Joint
Jenkins Bros., New York.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

Pans, Shop
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Patents
Baldwin, Davidson & Wight, Washington, D. C.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Field, Chas. H., Providence, R. I.
Prentiss Tool & Supply Co., New York.
Washburn Shops, Worcester, Mass.

Patterns, Wood
Cincinnati Pattern Works, Cincinnati, Ohio.
Gobeille Pattern Co., Cleveland, O.
Hartford Pattern & Model Co., Hartford, Conn.

Pencils
Keuffel & Esser Co., New York.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Bench
Bartlett, E. E., Boston, Mass.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Franklin Mach. Wks., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.

Presses, Hand
Perkins Mach. Co., So. Boston, Mass.

Presses, Hydraulic
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Dill Mach. Co., T. C., Phila., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.
Prentiss Tool & Supply Co., New York.
Wold & Co., Torris, Chicago, Ill.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulley Turning and Boring Machines
American Pulley Co., Phila., Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pulleys
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Howard Iron Wks., Buffalo, N. Y.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

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Evans Friction Cone Co., Boston, Mass.

Pulleys, Speed Changing
Speed Changing Pulley Co., Indianapolis, Ind.

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Watson-Stillman Co., New York.

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Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
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Standard Tool Co., Cleveland, O.
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Carlin Mchry. & Supply Co., Allegheny, Pa.
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Hill, Clarke & Co., Boston, Mass.
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Potter & Johnston Mach. Co., Pawtucket, R. I.
Steptoe & Co., John, Cincinnati, O.

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Reade Mchry Co., Cleveland, O.

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New Haven Mfg. Co., New Haven, Conn.
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Fosdick Mach. Co., Cin., O.
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Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
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Hammacher, Schlemmer & Co., New York.
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Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
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Tools
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Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
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Potter & Johnston Mach. Co., Pawtucket, R. I.
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Windsor Mach. Co., Windsor, Vt.

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Etna Mfg. Co., New York.
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Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

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Valves
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Graham Mfg. Co., Provi., R. I.
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Vises, Metal Workers'
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Wyman & Gordon, Worcester, Mass.

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National Machy. Co., Tiffin, O.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

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Mossberg & Granville Mfg. Co., Providence, R. I.

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Automatic Mach. Co., Bridgeport, Conn.

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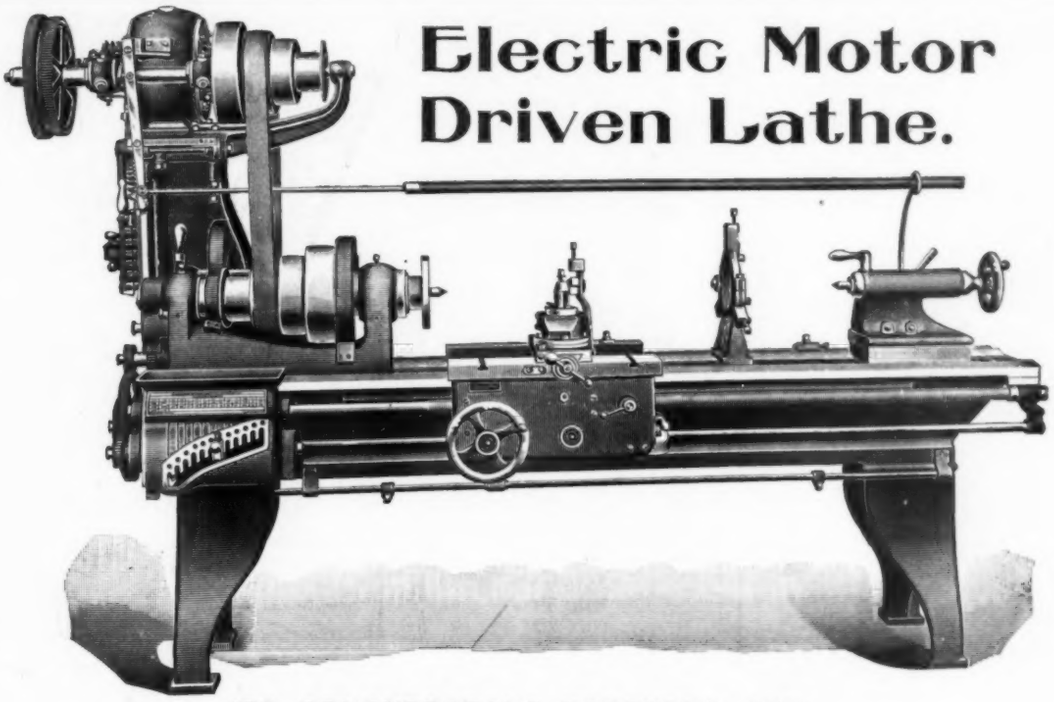

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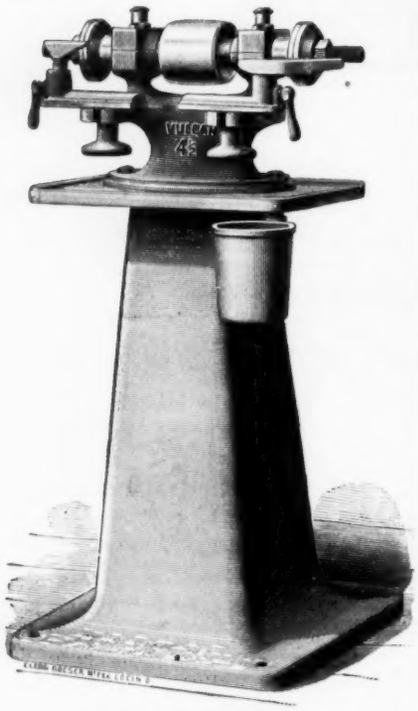

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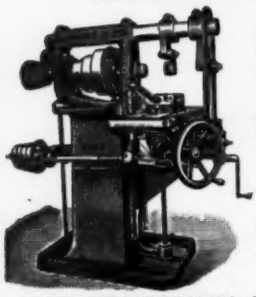

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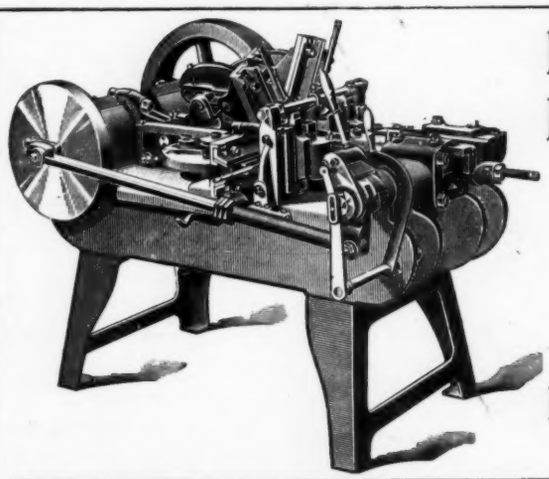

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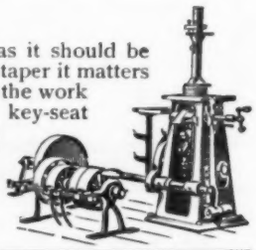

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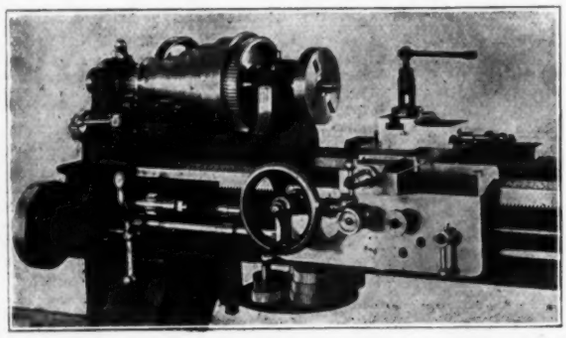

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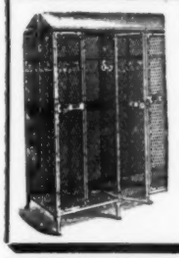

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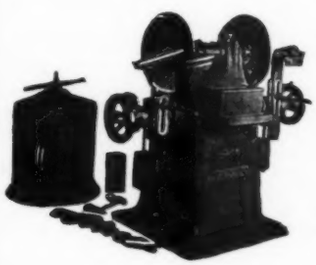

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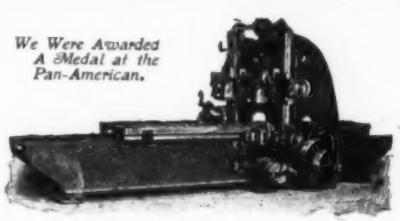

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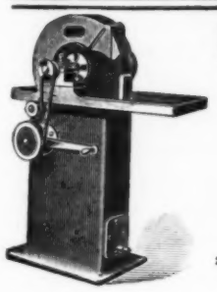

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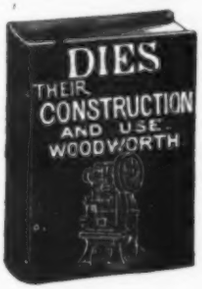

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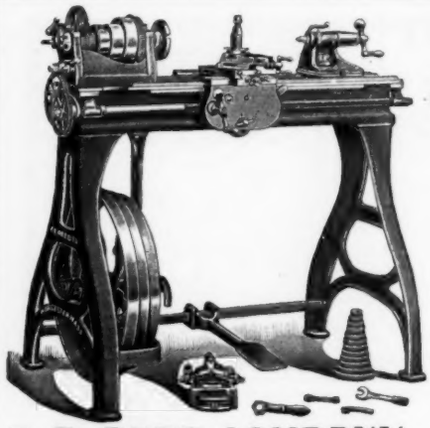

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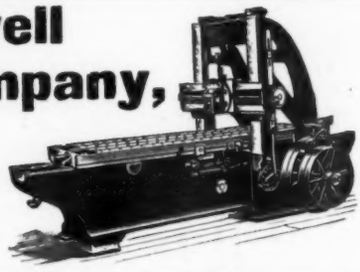

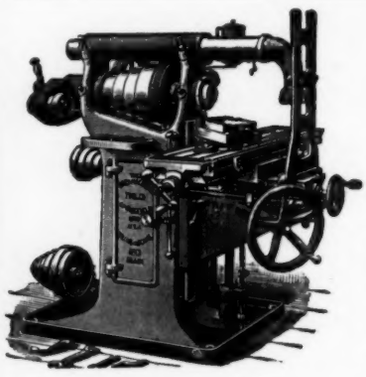

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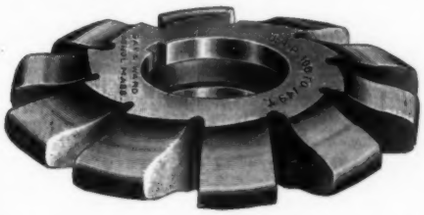

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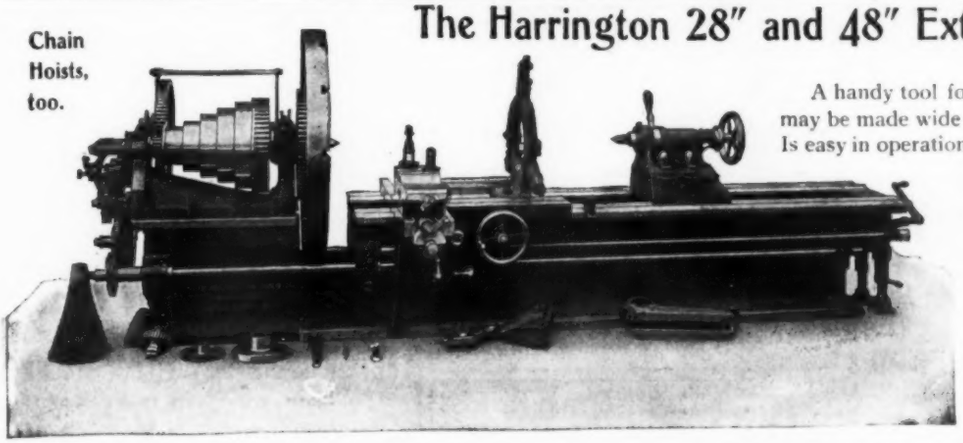

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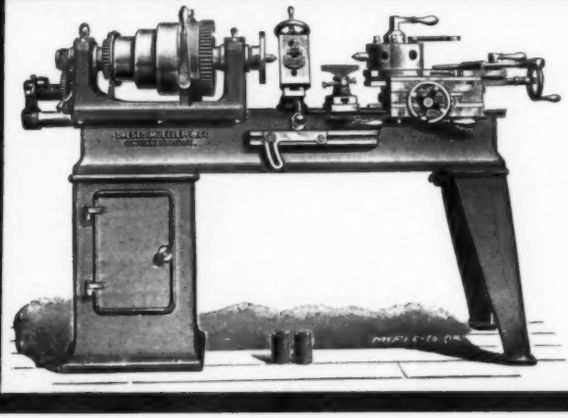

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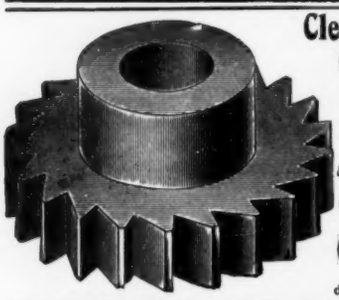

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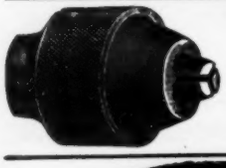

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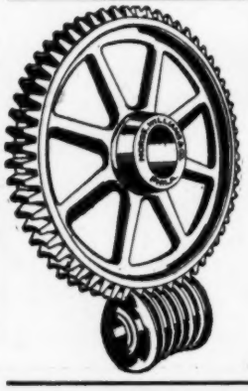

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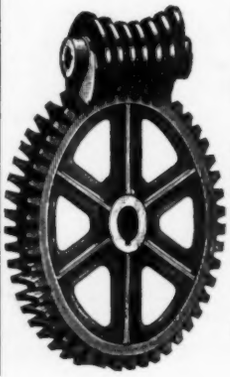

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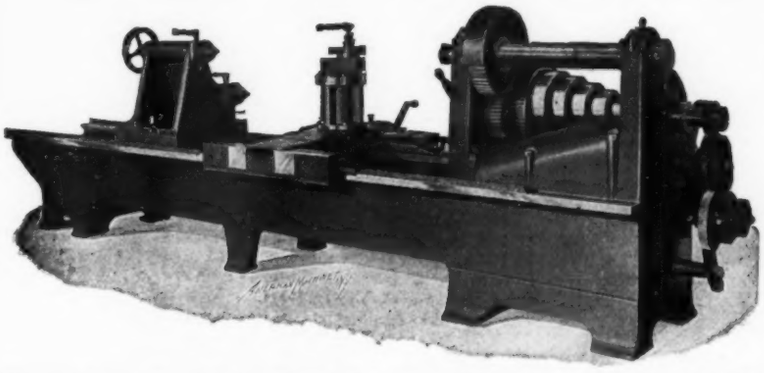

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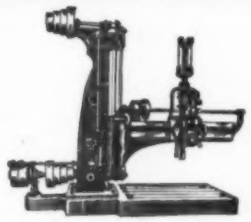

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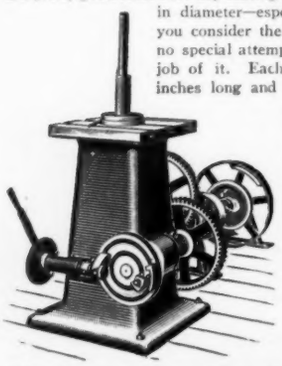

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MOULD AND LADLE

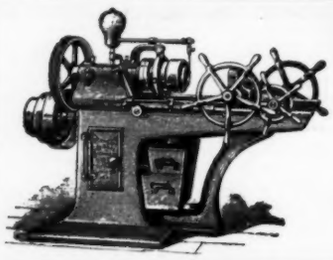
for making Soft Metal Hammers

(2 SIZES.)

PRICE—3½ and 6 lbs. with one hammer, $1.50 and $2.00
Extra handles, $2.00 per doz.

CHARLES H. FIELD, 234 Chestnut St., Providence, R.I.

American Mills Supply Co., Agents, 25 Victoria St., London, Eng. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm, St. Petersburg.

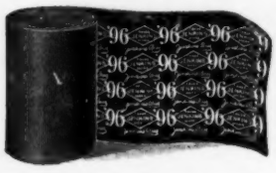


BOLT CUTTERS

Nut Tappers, Headers, Wire Nail, Spike, and Special Machinery.

SEND FOR CATALOG B.

NATIONAL MACHINERY CO.,
TIFFIN, OHIO, U.S.A.



JENKINS '96 PACKING

Makes perfect joint instantly; does not have to be followed up. Makes joint that will last for years on all pressures of steam, oils, acids, etc. Does not rot, burn, blow or squeeze out. Received the highest award—Gold Medal—at the Pan-American Exposition. All genuine stamped with Trade Mark.

JENKINS BROTHERS, New York, Boston, Philadelphia, Chicago.
62 Watling St., Queen Victoria St., London, E.C.

ETNA TAPS

do better and more accurate work than any others, because they are made of special grade tool steel. Each one is patent relieved. These taps will lessen labor and save tapping time. We also make drills and reamers. Shall we send you a catalog?

Etna Manufacturing Co., 41 John St., New York, N. Y.

CRANE VALVES

ESTABLISHED 1855

Speed Changing Pulley

Why not use the best device for changing speeds?

It is strong and simple; has great range and quick action; is self-contained; takes up small space, and can be placed on any countershaft in same space formerly occupied by cone. Adaptable for all purposes where change of speed is required. No machine tool is complete without it.

Every pulley has our guarantee.

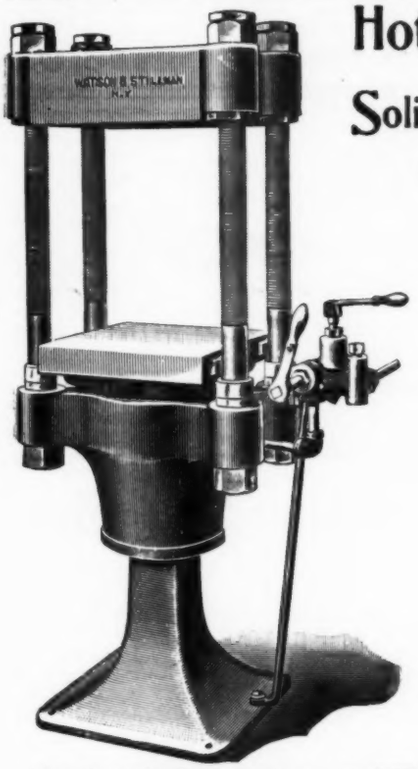
Speed Changing Pulley Co.,
750 East Washington St., INDIANAPOLIS, IND.

Walker Universal Tool and Cutter Grinder.

Complete Illustrated Catalog Free.

Especially Adapted to Tool Room Use.
For Sharpening all forms of Cutters, Reamers, End Mills, Counterbores, Etc.
For Cylindrical and Conical Grinding both Externally and Internally.

Made by NORTON EMERY WHEEL CO.
Office and Works at Worcester, Mass, U. S. A.



Hot, Chilling, or Solid Platen Die Presses,

with Adjustable Top Platen.

These presses are made with more area than the regular chilling and hot die presses. The moving platen being a close fit to the rods, the dies may be heated or chilled in the press, while under pressure, the dies lying loose between the two platens. The upper platen is made adjustable for several inches by long threads on the rods, nuts being provided to support the platen from below, and made flush with the surface, while the strain is taken by the nuts and jaw nuts above. Send for circulars.

WATSON-STILLMAN CO.,

202 E. 43d Street, New York City.

Chicago Office, 453 Rookery.
Selig, Sonnenthal & Co., London. Adolphe Janssens, Paris, France; Brussels, Belgium.

The Clutch Lever

on our 20" and 26" Back Geared Crank Shapers permits you to stop the machine and examine the work without stopping the countershaft. There are other Kelly features you ought to know about. They're in the catalog.

Lieber's Code Used.

The R. A. Kelly Co.,
Xenia, Ohio, U.S.A.

On Every Hole You Drill

you save time using a *Gang Radial Drill* because the spindle movements—

Forward—Stop—
Backward—Stop—

and Back Gear engaged are all controlled by one lever

Catalog A

gives a plain, "straight from the shoulder" talk and leaves no detail unexplained.

THE
Wm. E. Gang Company,
CINCINNATI, O., U. S. A.

Twice the Strength of Welded Chain.

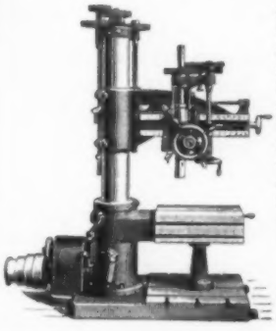
TRIUMPH PATTERN.

State your requirements that we may send free sample. Our Chains are to be found in all hardware and mill supply houses that are up to date.

SEND FOR CATALOG "7A."

The BRIDGEPORT CHAIN CO., Bridgeport, Conn.

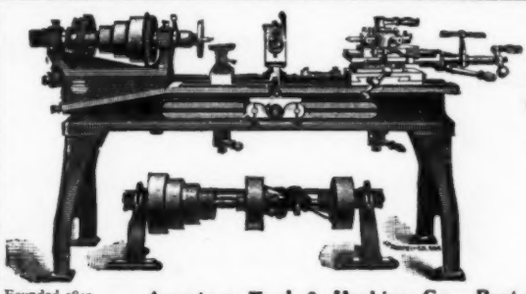
Symmetry AND Strength



unite to make our *New Radial Drill* a model of all a radial drill should be. It has a lot of valuable improvements such as the crank at the base of column that controls SIXTEEN SPINDLE SPEEDS without stopping the countershaft.

Better Get Acquainted With It.

Mueller Machine Tool Co.,
Cincinnati, Ohio, U.S.A.



LATHES

For Brass and Iron Workers' Use.

Our No. 2 TURRET LATHE shown in the engraving is of the most approved design and construction for perfect work and is "built to last." It is unquestionably the BEST lathe for use on brass work of all kinds, and on medium iron work.

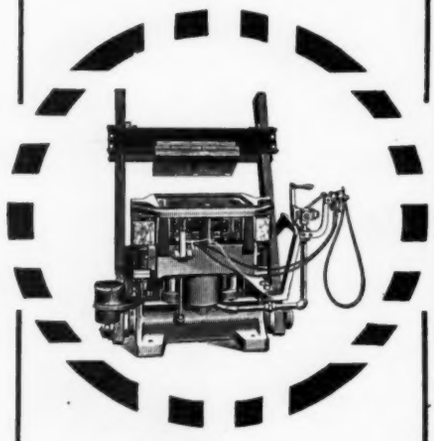
Get our latest Catalog with full particulars.

Founded 1845. Incorporated 1864. American Tool & Machine Co., Boston, Mass. Agents for the Otto Gas Engine Works.

Increased Output
Increased Profits

and a high grade of uniform regular work turned out, is the result obtained

By Installing



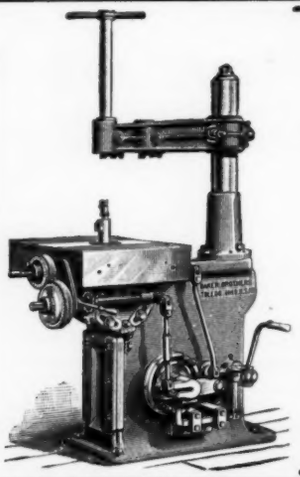
Tabor Vibrator Molding Machines

Saves Sand, Material, Pattern Costs and Labor.

Let us send you some facts about what The Tabor Machine is doing in certain well known foundries.

The Tabor Mfg. Co.,
18th and Hamilton Streets,
PHILADELPHIA, PA.

AGENTS—Machinery Trust, Ltd., Co., 189 Fleet St., E. C., London, Eng. Dominion Radiator Co., Ltd., Toronto, Ont., Can. Schuchardt & Schutte, Berlin, Brussels, Vienna, St. Petersburg.



SAVE MONEY

By buying the best labor saving tool,

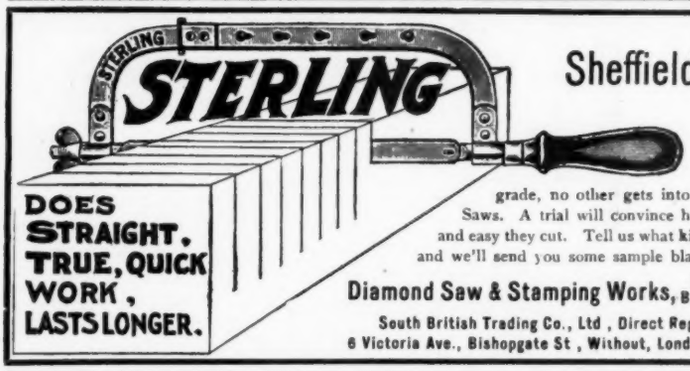
The Colburn Keyseater

with automatic feed and automatic relief and stop. Built in eight sizes.
Does a large variety of other work besides keyseating, such as internal slotting, internal ratchets, internal gears, etc. Work chucked any way, by the bore, by faced hub or rim.

We also build the best Tapping and Boring Machines

for tapping Pipe Fittings and flanges from 2 in. to 16 in.

BAKER BROS., Toledo, O.



Sheffield Steel

of the highest grade, no other gets into "Sterling" Hack Saws. A trial will convince how straight, quick and easy they cut. Tell us what kind of work you do and we'll send you some sample blades to try.

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South British Trading Co., Ltd, Direct Representatives, 6 Victoria Ave., Bishopgate St, Without, London, E.C., England.

Have any trouble Threading Pipe?

"A new one for a poor one."

If you do, you're not using Oster Ratchet Stocks and Dies. It's no trouble with them. They cut a clean, perfect thread the first time, and there's no time or money lost in backing them off. They're quickly opened and they center themselves. Adjusted in almost no time for variations in fittings. As rigid as can be. Red Catalog B tells the whole story.

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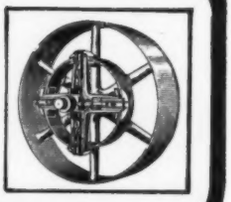
FRICTION CLUTCH PULLEYS, TRIED and TRUE

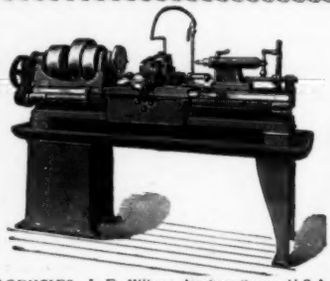
The Caldwell kind has been tested by years of the most exacting service. It has never been found weak or wanting in any particular, but has repeatedly demonstrated its superiority in everything that goes to make a friction clutch durable and desirable. This clutch is guaranteed to transmit the full horsepower of a double leather belt as wide as the face of the pulley. Cheaper in the end than tight and loose pulleys—better from the beginning. Circular free.



We also manufacture Elevating, Conveying, and Power Transmission Machinery of all sorts.

Eastern Sales and Engineering Office,
R. T. PEARCE, Mgr.
410-95 Liberty St., New York, N.Y.

H. W. CALDWELL & SON CO.,
Western Ave. and 18th St., Chicago, Ill.



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AUTOMATIC THREADING LATHE
FOR
WORMS and SCREWS.

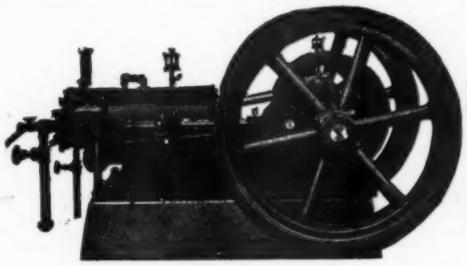
50 to 90% SAVING GUARANTEED.

See Large Ad. Am. Machinist of Dec. 4, 1902.

SEND FOR CIRCULARS.

AUTOMATIC MACHINE COMPANY
Bridgeport, Conn., U.S.A.

AGENCIES—J. E. Wilson, Eastern States, U.S.A. Selig, Sonnenthal & Co., London, England. Schuchardt & Schutte, Neuss, Germany.



The Warren Gas Engine.

Awarded Gold Medal at Pan-American Exposition, 1901.

Single Cylinders, 3½ to 90 Actual H. P.
Double Cylinders, 25 to 500 Actual H. P.

Large sizes in successful operation driving dynamos for lighting and power purposes. Inquiries solicited for large units to operate with natural, illuminating or producer gas.

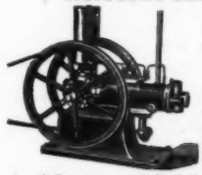
Struthers-Wells Company
WARREN, PA.
New York Office: No. 26 Cortlandt Street.

FOOS **GAS AND GASOLINE ENGINES.** 2 to 250 H P. **FOOS**

Highest grade engines for all power purposes.
Largest exclusive gas engine factory in America
Engines held in stock in principal cities for quick delivery.
Send for our new illustrated catalog M.

FOOS GAS ENGINE CO., Station G., Springfield, O.

THE MIETZ & WEISS
Kerosene and Gas Engines.

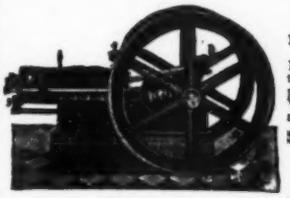


Self-igniting, Automatic, Simple and Reliable. For pumping, electric lighting and all power purposes. Sizes from 1 to 60 H.P.

Awarded Gold Medal at Pan-American Exposition, Buffalo, 1901. Highest Award for Direct Coupled Engine and Generator, Paris Exposition, 1900. ☞Send for Catalog.

A. Mietz, 128 Mott St., New York.

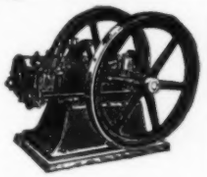
Stationary, Portable & Pumping ENGINES



THE BEST IS ALWAYS THE CHEAPEST. Power for every class of work. Engines sold on their merits and power guaranteed. Write for catalog and prices.

STOVER ENGINE WORKS,
Box 3°3.
FREEPORT, ILL.

"New England" Gas and Gasoline Engines
3 to 30 Horse Power.



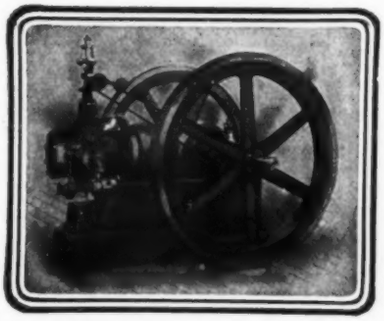
Each and every part made of the best material suitable for the purpose, solid steel forged crank shaft and connecting rod without bends or welds in either; special and simple method of taking up the lost motion; speed of engine easily changed while in operation, and time of ignition readily regulated. Engines are thoroughly guaranteed in every particular.
If interested, we will be pleased to send catalog and submit proposition.

NEW ENGLAND GAS ENGINE COMPANY,
48 Washington Street, North, BOSTON, MASS.

Automatic Engines

of rare worth are those built by Chandler & Taylor. They combine more features of merit than any other engines built. They are of a higher economy of operation; they last longer. They are built from material best suited to the various needs. Each part has had distinct designing as regards its individual part of the engine, as well as its relation to the whole. The many details are fully described in Engine Book, which it is our pleasure to send on request.

Chandler & Taylor Company,
Indianapolis, Ind., U.S.A.



Vertical Poppet Valves

Can use gas, gasoline, or both, and change from one to the other while engine is at full speed. Can change point of igniting while engine is at full speed. Three main crank shaft bearings; counter balances in discs attached to crank throws; all parts easily accessible. Overhanging cylinder allowing equal expansion at all points. Close regulation of speed; simple in mechanism. Write for catalog B.

Gas and Gasoline Engines.

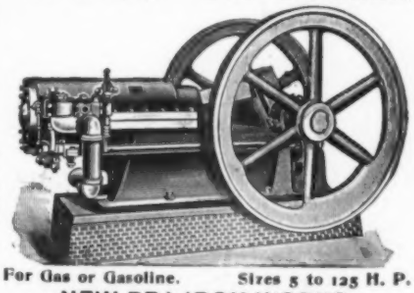
Elyria Engine Co.,
ELYRIA, OHIO.

Uniformity of Speed

Is one reason why "National" Gasoline Engines are used in so many small electric light and factory plants. You can depend on "National" Engines for safe, satisfactory service every day in the week.

National Engine Company,
Rockford, Ill.

"NEW ERA" GAS ENGINES.



For Gas or Gasoline. Sizes 5 to 125 H. P.
NEW ERA IRON WORKS,
25 Dale Avenue, - Dayton, Ohio U.S.A.

Here's a Good Gas and Gasoline Engine.

Compact, portable, powerful, rigidly mounted. Starts well, runs well, wears well, and doesn't cost too much. Write for details.

N. Y. & Foreign Agents: The Frasse Co., 38 Cortlandt Street. Phila. Agents: Lovegrove & Co., Inc., 145 N. Third St.

MAKERS,
COOPER MACHINE CO.,
SALTSBURG, PA.

Eclipse Corliss Engines.

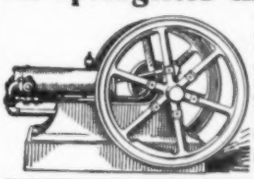
40 to 2,000 H.-P. All Styles.
Electric Speed Engines.

Ice Making and Refrigerating Machinery.

Engine Catalog E. Ice Machinery Catalog M.

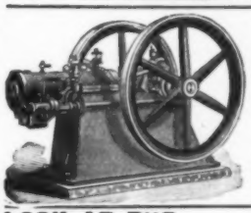
FRICK COMPANY, Waynesboro, Pa.
NEW YORK 39-41 CORTLANDT STREET.

The "Springfield" Gas and Gasoline Engines



Using Natural Gas, Coal Gas, Producer Gas and Gasoline direct from the tank. 2 to 40 H. P. **Interesting Catalog.**

THE SPRINGFIELD GAS ENGINE CO.,
30 W. Washington St.
Springfield, Ohio.

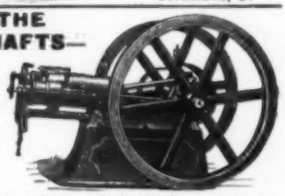


Gas and Gasoline Engines

embody new and important departures in design and operation. Send for catalog "H."

COLUMBUS MACHINE CO.,
Columbus, O.

LOOK AT THE CRANK SHAFTS—



large in diameter and so strong—all solid steel forged. No chance for shaft to break, or balance wheel to quiver, in an

OLDS GAS OR GASOLINE ENGINE. Safe, sure and economical. Stationary engines, 1 to 50 H.P. Portable engines, 4½, 8 and 12 H.P.

Write for Catalog. **OLDS MOTOR WORKS,**
228 River St., LANSING, MICH.

The Champion Blower & Forge Company,
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Manufacturers of the Celebrated **Champion Steel Blower and Forges.**

Guaranteed to do 25 per cent. more work than any other Blower, Forge or Bellows ever built.
Write for 1902—212-page Catalog.

REGAL GASOLINE ENGINES

Stationary and Marine. We make a specialty of 2½ H. P. to 8 H. P. Just the size you want for power in the shop. They are high grade, easy to operate, have no complicated parts to get out of order, and give satisfaction. If you want a good engine, that can be relied upon at all times, write us for Catalog 14. It tells about them.

REGAL GASOLINE ENGINE CO.
COLDWATER, MICH.

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NEW YORK.

Branches: Chicago, St. Louis and San Francisco.

Measuring Tapes.

We make the largest variety of Steel and Metallic (Woven) Tapes. Steel Tapes ½, ⅜, 7/16, ¼, 3/16 in. wide, in sewed leather and steel case and on reel. All warranted accurate.

K & E. Armor Tapes, ⅜ in. wide, in stout, nickel plated case:

Length, feet,	25	50	75	100
Price, each,	$2.70	$3.30	$4.35	$5.60

Steel Pocket Tapes, in patent German silver case: 3, 5, 6, 9, 12 ft. long.

Circumference Tapes for determining diameter from circumference, or vice versa.

Complete catalogue on application.

We are direct importers of the celebrated

Koh I Noor Pencils,

of which we carry a complete stock; also

Koh I Noor Artist Leads,
Koh I Noor Copying Pencils,
Mephisto Copying Pencils,
Hardmuth's Pliable Rubber.

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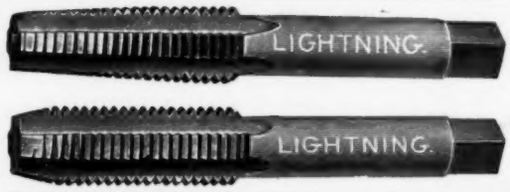
9 of these Nicholson Expanding Mandrels take the place of tons of solid ones.

They hold the work better, they are always ready, they are always right. Book telling why on request.

W. H. NICHOLSON & CO.

WILKES-BARRE, PA., U.S.A.

Foreign Agents—C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm, St. Petersburg. Adolphe Janssens, Paris.



FINEST
Machine Relieved Taps
ALSO
Dies, Screw Plates, Reamers, Etc.
Send for Catalog
Wiley & Russell Mfg. Co.
Greenfield, Mass., U.S.A.
SELIG SONNENTHAL & Co., 85 Queen Victoria Street, London, England

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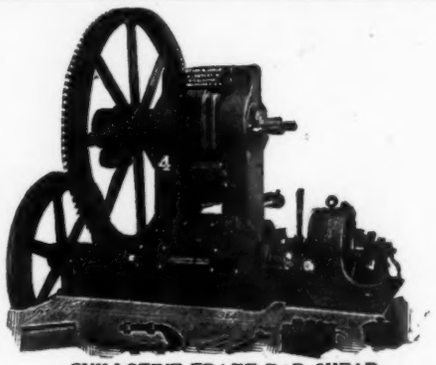
Standard Machine Tools

For BRIDGE WORKS
STEEL CAR PLANTS
BOILER SHOPS
SHIP YARDS, Etc.

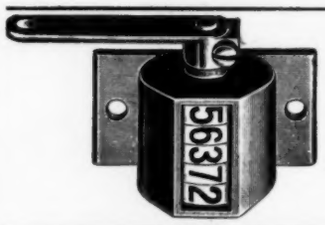
Hilles & Jones Company,

WILMINGTON, DELAWARE.



GUILLOTINE FRAME BAR SHEAR

This type of shear is made in eight different sizes, and for driving by pulleys, steam engine or electric motor. Knives may be made in sections if preferred, so that both flats and rounds can be sheared without changing.



Ratchet & Rotary Counters

for voting machines, nickel-in-slot machines and automatic machinery generally, to register number of pieces or quantity produced—for any purpose requiring a small, light and accurate instrument.

THE VEEDER MFG. CO., Hartford, Conn.

Makers of Counters Cyclometers, Odometers, Fine Castings.

CRANE FITTINGS

ESTABLISHED 1855

Quick as Wink Couplers

on your air hose would please you. They are more convenient than Screw Couplers and save a lot of time. Try them. Many Shops use them.

MADE ONLY BY THE W. J. CLARK CO., SALEM, OHIO, U.S.A.

Steel Castings

from one pound to ten tons.

Uniform Steel Co.

Rahway, N. J.

Pressed Steel Shop Pans,

STEEL SHOP BARRELS.

All Styles and Sizes. Any Gauge of Steel.

PLAIN, PAINTED, GALVANIZED.

The KILBOURNE & JACOBS Mfg. Co.

Lock-Drawer G,
COLUMBUS, OHIO, U.S.A.

QUINT'S TURRET DRILLS.

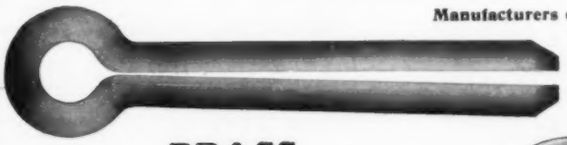
Four sizes. With any number of spindles. Will drill and tap from the smallest hole up to 9 in.

A. D. QUINT,
3 Clinton Street, Hartford, Conn.

The Standard Tool Company

CLEVELAND, OHIO, U.S.A.

Manufacturers of



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All Sizes to Order Promptly.

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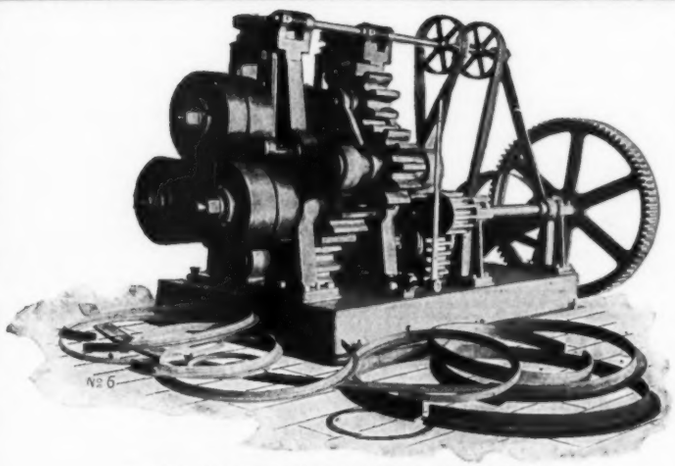

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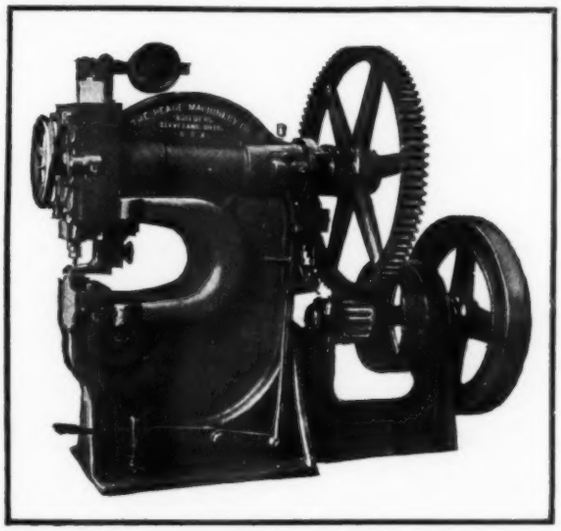

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Will punch ¾" thro' ¾" and will shear ½" plate, 1¼" round or 3x3" angles.

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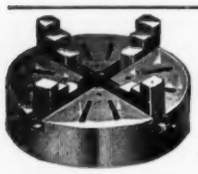

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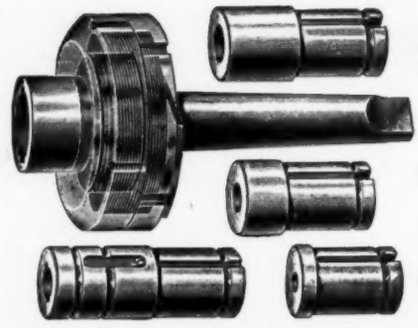

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Efficiency, Convenience, Rapidity, Accuracy and Simplicity.

Nothing to *Break* or get out of *Order*. Made in 4 sizes, covering from 0 to 2⅝ in. diameter.

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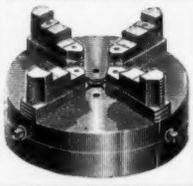

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moves the jaws universally in the Skinner Combination Lathe Chuck. It's a chuck well worth investigating. Catalog explains its simplicity and gives reasons for its great strength. It's yours for the asking.

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Your Lathe will last longer and do better work. So will the Chuck.

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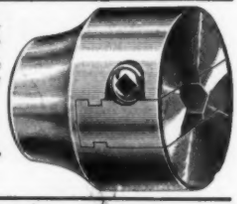

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There's Just One Drill Chuck

that holds drills so they can't slip—that holds them without cutting threads on their shanks and without strain on the chuck. There's only one, mind you, and that one is the "Pratt." In the "Pratt," an equalizing driver keeps the drill from slipping—the jaws only center it and keep it from falling out. In other chucks the jaws have to do all the work. They do it as long as they can stand the strain, then something gives way and there's a repair bill or an addition to the scrap heap. Booklet free.

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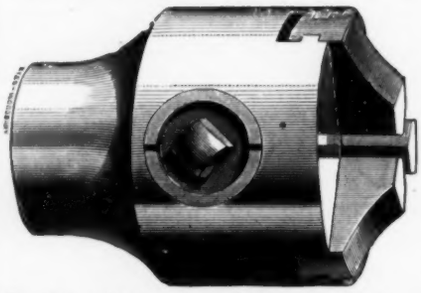

A key operates it so that the drill is held firmly and true. Once fastened there's no slip—no chance to slip. It is arranged for attachment to drill or lathe by means of a taper mandrel. It can also be threaded to screw on if desired. It's accurately made, in the Whiton way, and it's durable.

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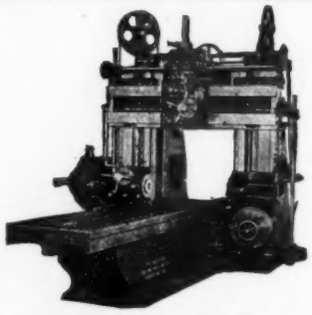

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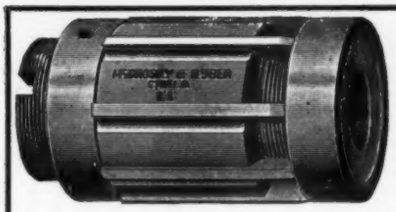

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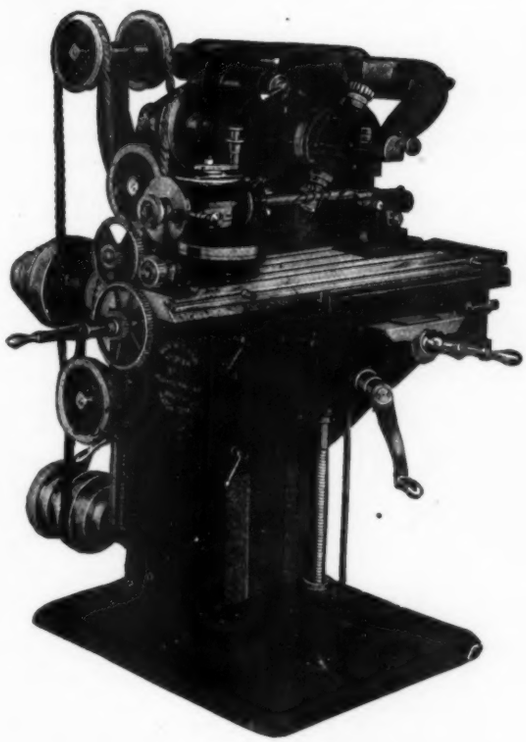

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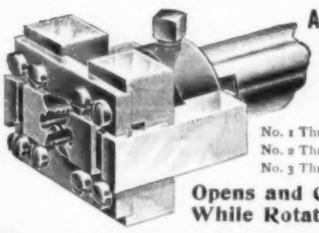

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Pipe 3/8"
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No. 1 Threads to 3/8"
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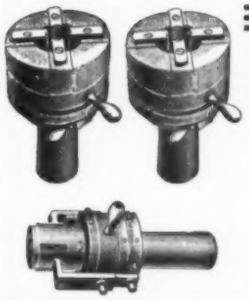

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increases output over 50%. Has micrometer attachment to cut tight or loose threads.

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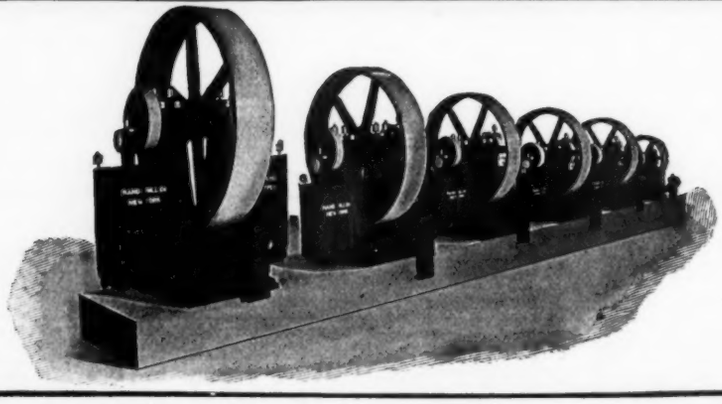

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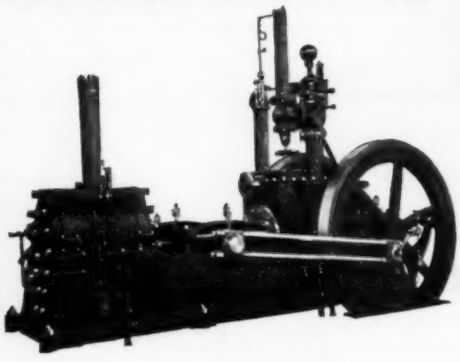

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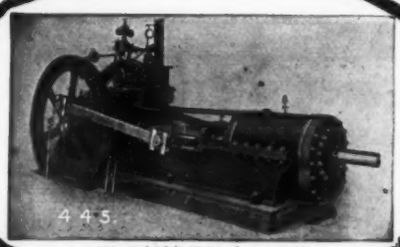

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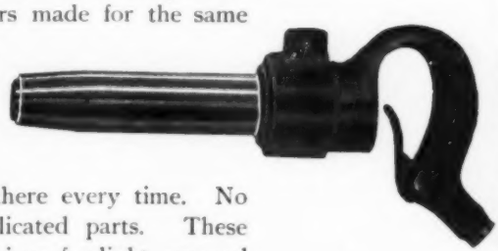

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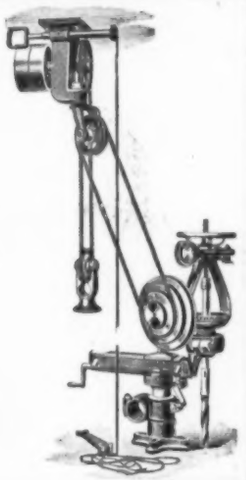

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It's easily placed—drills at any angle, any position, any distance, any direction from power. Our free Drill Book tells all about it.

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FOR PLANING LARGE SURFACES.

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No.	Size Shank, Inches	Size Cutter, Inches	Feed Adjustment, Inches	Price Complete
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SPECIAL DYNAMOS FOR ELECTROTYPERS AND PLATERS.

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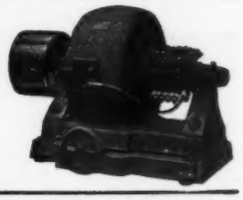

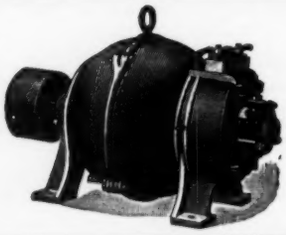

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of superior design and construction for driving all kinds of machines with economy and precision are described in our bulletin No. 20613. Our bulletin No. 20713 shows various applications of the electric drive.

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Drive your Machine Tools with . . . .

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Electric Motors

They are compact in design, accurate in construction and superior in performance. They are the latest type and embody all the features that have been found advantageous in actual service.

. . . Write for Catalogue No. 40. . .

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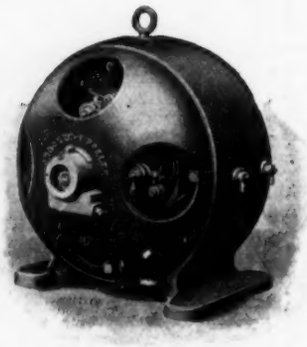
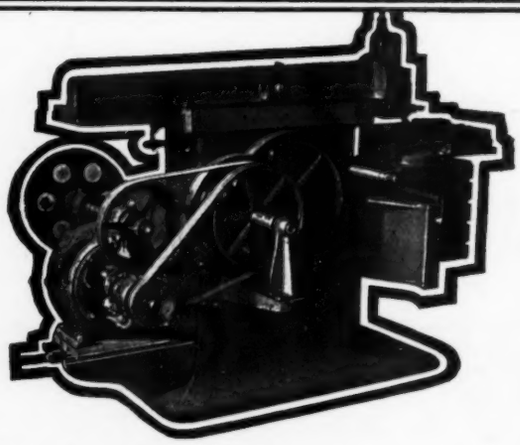


Semi and Fully Enclosed Motors for Application to Machine Tools.

For further information see our Bulletin No. 29.



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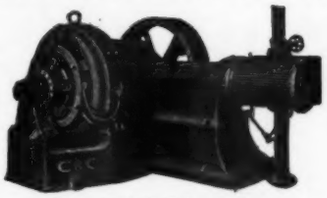

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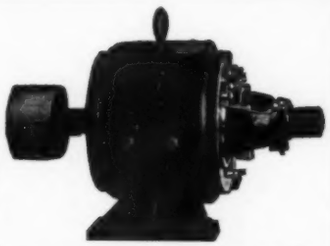
If Interested In Dynamos and Motors,



our 12-page circular describing the Robbins & Myers Direct-Current Dynamos and Motors should receive your careful perusal. It gives all the details and explains the Robbins & Myers construction and just why they are being adopted in many good shops.

Robbins & Myers Company, Main Office and Works: **Springfield, O.**

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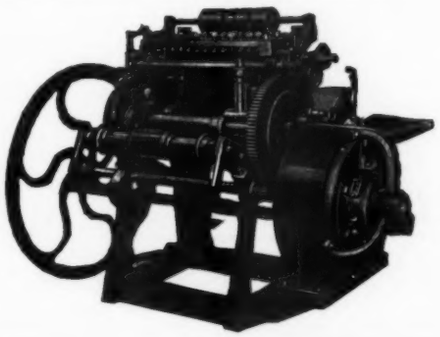

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Do it in any manner desired

FOR WE MAKE
Motors of all kinds, all types and for all applications.

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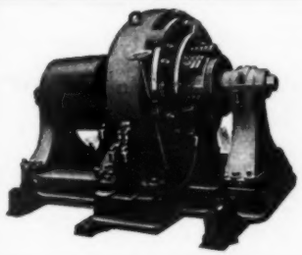
POWER AND LIGHTING APPARATUS — MOTORS GENERATORS SWITCH BOARDS		COMPLETE INSTALLATIONS — WRITE FOR BULLETINS AND OTHER INFORMATION
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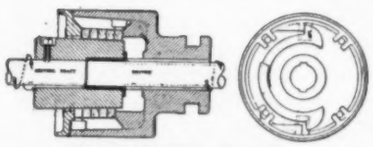

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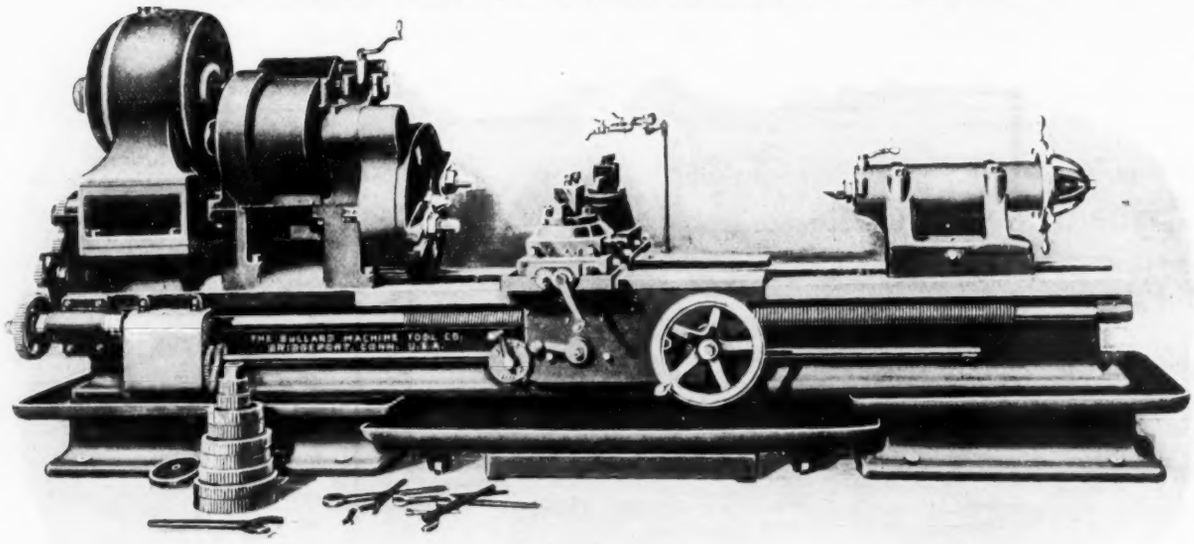

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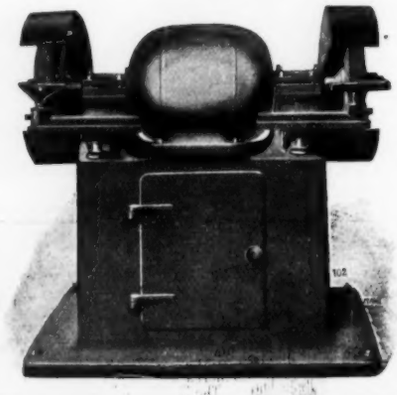

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No Delicate Mechanism to cause
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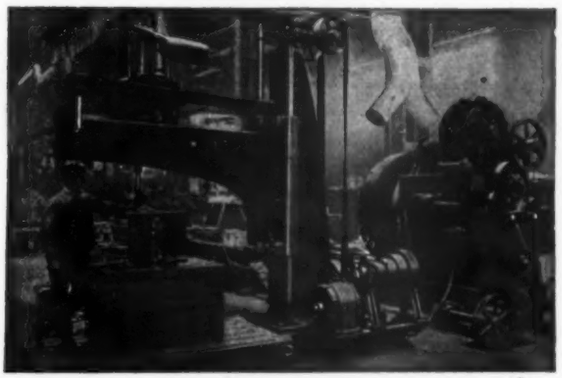
Write nearest Office for Circular 1050.



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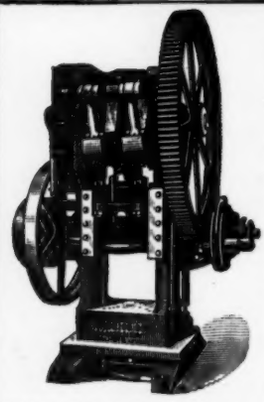

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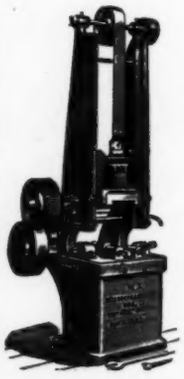
Hammers from 50 to 1,200 lbs.



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This one weighs 7,500 pounds. Has a bolster plate 30″ x 33″ and a plunger stroke of 2½″. It's 11″ from bed to bottom of slide when stroke and adjustment are up, 26″ between standards, 15″ back from center of slide, and has a 26″ opening in bed. Built in other sizes, down to 500 pounds, and a great favorite with large tin manufacturers.

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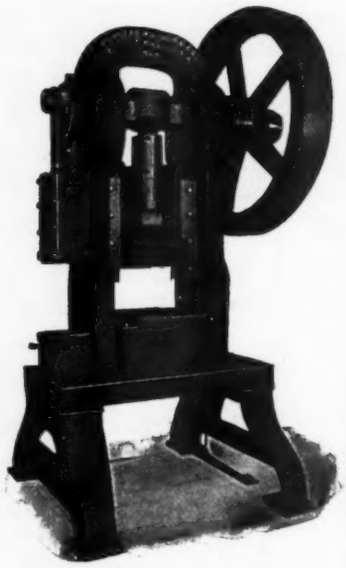
Perkins has a press for your every press want, and the press that Perkins supplies will be found to be a much better press for the purpose than you can get elsewhere; then if there comes the possibility that Perkins hasn't the exact thing, Perkins will make you one. By going to Perkins at the start you save all sorts of time and trouble. Perkins Presses may be seen at the Prentiss Tool & Supply Co., 115 Liberty St., New York.



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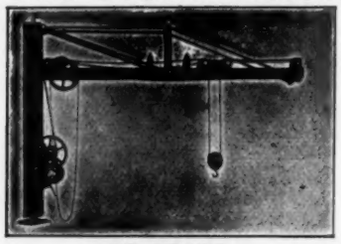

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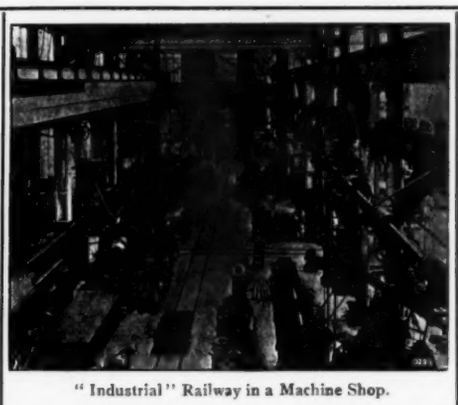

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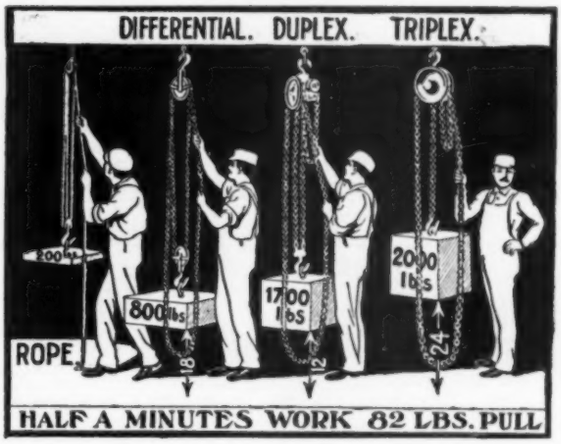

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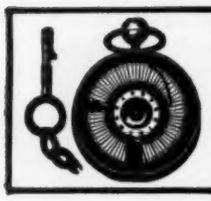

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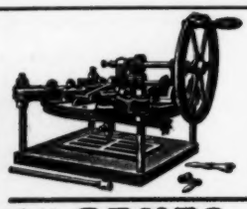

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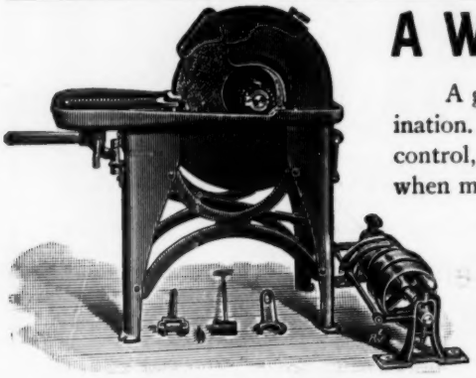

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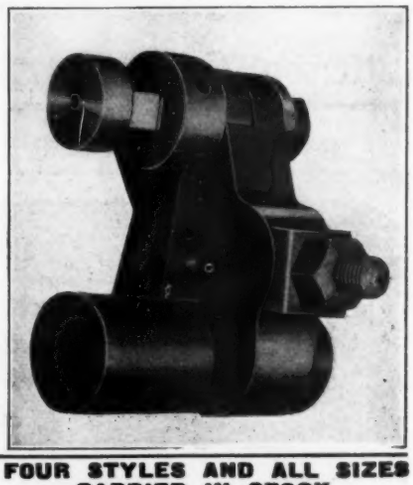

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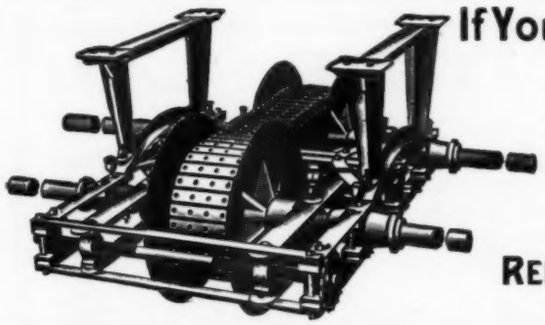

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along at the same slow pace, taking light and heavy cuts on tool steel, cast iron and brass at the same gait because it's too much trouble to shift belts or impossible to get the right speed through a cone pulley, your profits will plod, too. "The Reeves" Variable Speed Transmission is the remedy—any speed at any time, without stopping machine or shifting belts. Catalog free.

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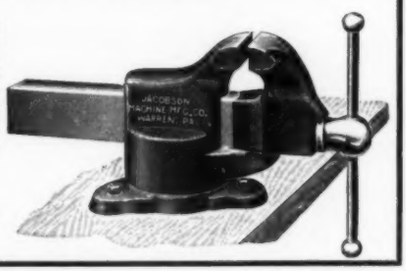

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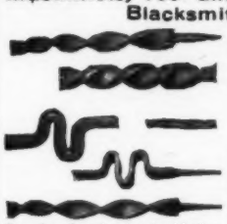

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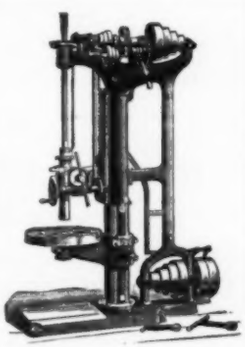

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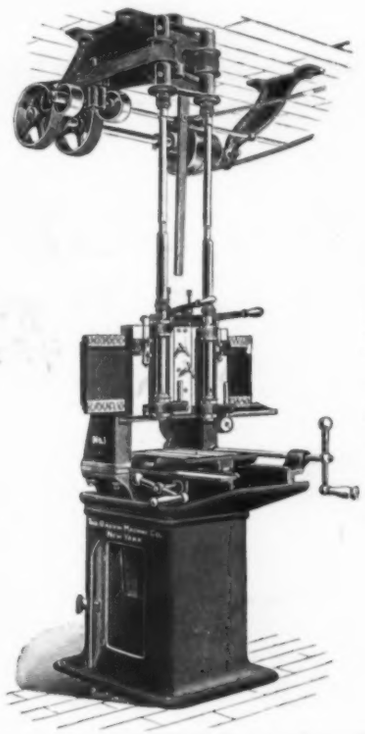

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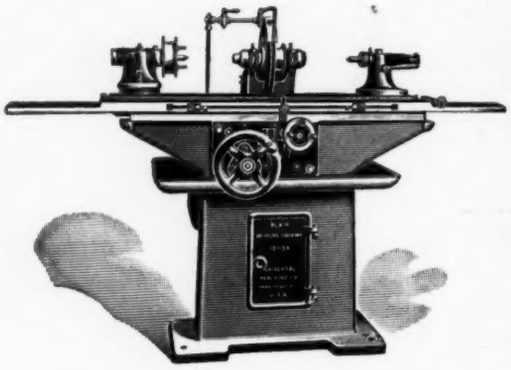

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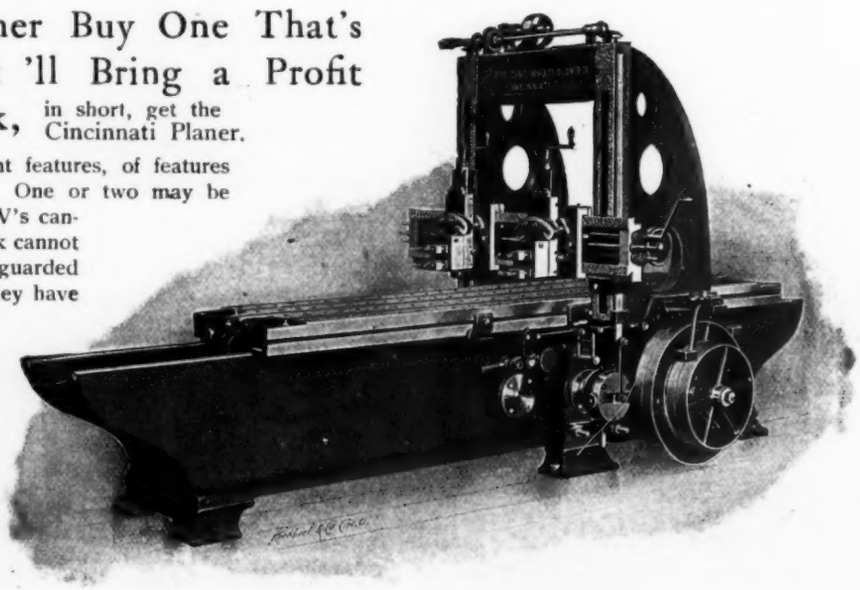

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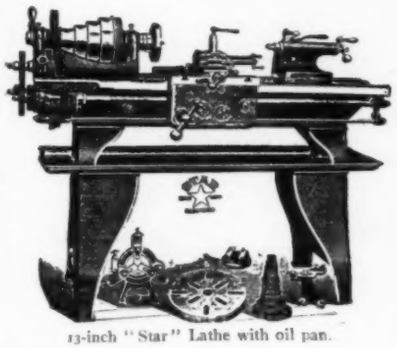

13-inch "Star" Lathe with oil pan.

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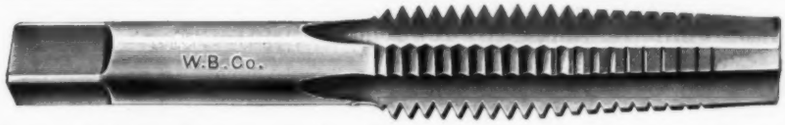

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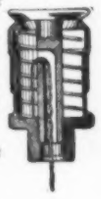

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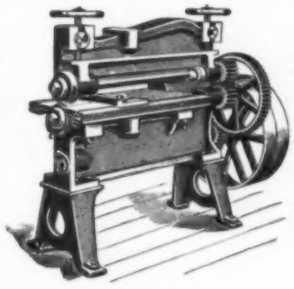

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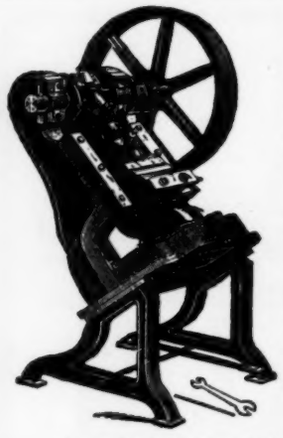

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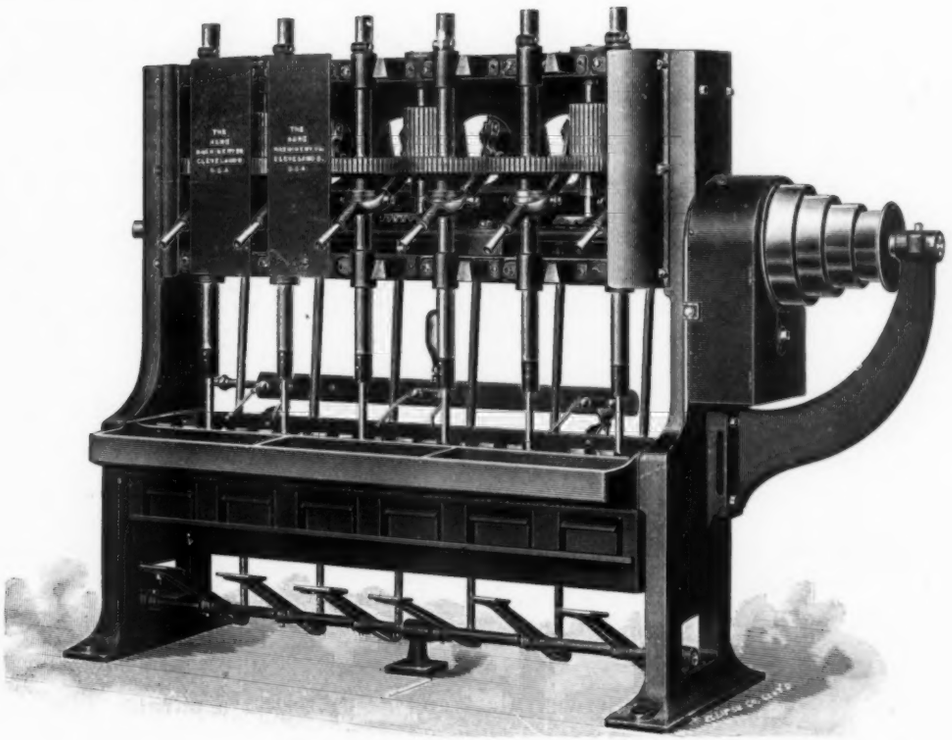

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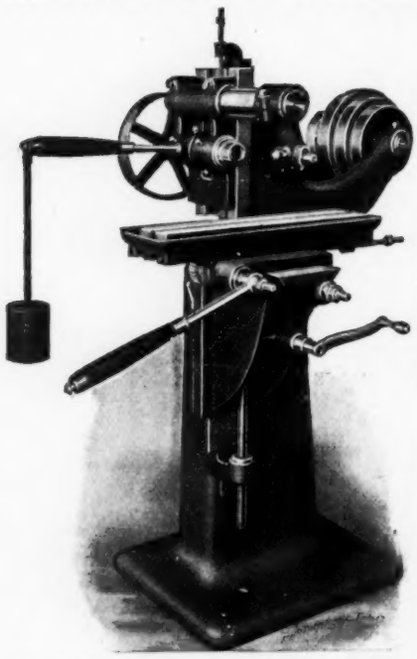

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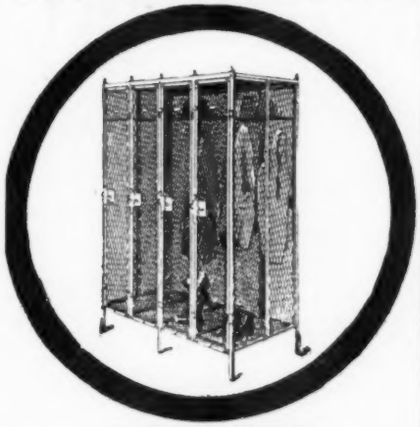

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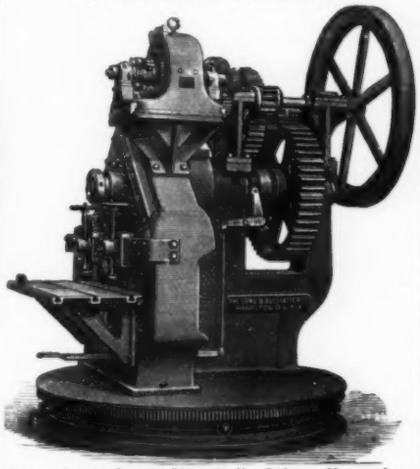

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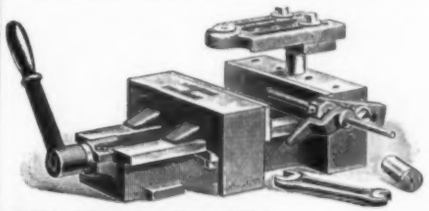

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26 in. throat, capacity 1¼ x 1, weight 14,000	36 in. throat, capacity 1¼ x 1, weight 18,000

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Univ. Miller, Kempsmith	Screw Machine, 1 13-16 in., No. 4, wire feed, friction head, Bardons & Oliver
Plain Miller, Bk. gd. Brainerd	
Shapers, Crank and Gd.	
Power Presses, Stiles	Slotters, 8, 10 and 11 in.
Bolt Cutter, ½ in., National	Pipe Machines, 4 and 8 in.

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14 Dey Street, New York.

SECOND-HAND TOOLS.

3 20 in. x 10 ft. Bradford Lathes.
1 20 in. x 10 ft. New Haven Lathe.
1 22 in. x 10 ft. New Haven Lathe.
1 28 in. x 11 ft. New Haven Lathe.
1 30 in. x 12 ft. New Haven Lathe.
24 in. Ingersoll Horizontal Miller, 5 ft. table.
24 in. Bullard Turret Lathe, friction head.

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16 in. x 20 in. x 18 in. Hall, single.
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9 in. x 10 in. x 9 in. Clayton, single.
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90 in. Mackintosh Hemphill Radial.
70 in. Betts Radial.
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14 x 6 Blaisdell.	21 x 8 Pratt & W.
15 x 6 Pratt & W.	27 x 20 Pratt & W.
16 x 5 Pratt & W.	42 x 13 Pulley.
16 x 6 Flather.	42 x 20, with tpr., Nl's.
16 x 6 Ames Mfg. Co.	20 ft. swing Pit Lathe.
16 x 6 Fifield.	35 x 16 Fitchburg.
60 in. Driving Wheel Putnam.	28 x 14 Fitchburg.
16 x 8 Pratt & W.	25 x 12 Fitchburg.

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20 x 20 x 6 P. & W.	48 x 48 x 20 4-head Planer, Pond.
36 x 36 x 17 N. Y. Engine Co.	48 x 48 x 18 1-head Planer, Fitchburg.
60 x 60 x 12 2-head Planer, Miles.	10 x 7 x 46 Industrial Works, 2 heads.

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No. 1 Locomotive Cylinder Boring Mach., Newton.	28 x 12 Hori., Sellers.
3 in. Bar Horizontal, Frederick Miles.	60 x 12 Hori., Pond.
	14 x 16 Star Feed Boring Bar.

MILLING MACHINES.

No. 2 Hand, Garvin.	Ingersoll, planer type.
No. 3 Garvin.	Pratt & W., Lincoln.
No. 2 Plain, Garvin.	Double Col. Grant,
Hand, Ames Mfg. Co.	Pratt & Whitney.
48 x 14 Plain, B. & S.	6 ft. bed Duplex, Newton.
36 in. x 36 in. x 13 ft.	

MISCELLANEOUS.

No. 2 3-spindle Garvin Drill.	with Tower Crane, 15 tons capacity, 20 ft. span.
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16-spindle Car Wheel Drill, Niles T. W.	5 ton Hand Crane, 29 ft. span.
6-spindle Hendey Drill Press.	One Newton 8 ft. Floor Bor. Machine.
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24 in. Gould & E. Gear Cutter.	1,500 lb. Bement Stm. Hammer.
No. 2 Perkins Screw Press.	14 in. Slotter, Niles.
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22 in. x 10 ft. Eng. Lathe, Davis.
30 in. x 12 ft. Eng. Lathe, New Haven.
28 in. x 24 ft. Eng. Lathe, Wood & Light.
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38 in. B. G. & S. F. Drill, New Haven.
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22 x 10 Pl. R., Niles
20 x 8 C. R., Pratt & W.
20 x 22 Pl. R., Niles
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20 x 6 Pl. R., Gray
18 x 8 Pl. R. & taper, Pratt & W.
18 x 8 C. R. & taper, LeBlond
18 x 8 R. & F., Jones & Lam.
16 x 6 C. R., Porter
15 x 6 C. R., Prentice
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50 other 12, 14 and 16 in. Eng Lathes

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60 x 60 x 14 Sellers
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84 inch double head, Sellers
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60 " " " "

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60 " " Penny
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68 in. x 24 in. platen, univ., all feeds, vert. milling and rotary attachs., Pedrick & A.
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No. 3 Lincoln, Garvin
No. 3 hand, Garvin
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24 " B. G., P. F., Sibley & W.
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21 " W. & L., Hamilton
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20 " B. G., P. F., A. S. Davis
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25 sensitive and 20 in. Drills

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No. 3 Pratt & Whitney
No. 2½ " " "
No. 2 " " "
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25 Speed Lathes
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18 " " " " ⅝ in ⅝
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No. 1 plain Garvin
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Bench and hand millers, Garvin and Ames Lincoln millers

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16 in. x 8 ft. x 15½ in. Bradford
17 " x 17 in. x 4 ft. Whitcomb
30 " x 30 " x 5 ft. 4 in. Alamo
32 " x 24 " x 8 " Parsley
Complete stock of new.

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37 inch Double Head Bausb Boring Mill, like new
14 in. x 11 ft. single head Axle Lathe
16 in. x 11 ft. self centering, single head Axle Lathe

LATHES.

11 in. x 4 ft. 3 in., ft. pr. Barnes
11 " x 4 " Sebastian
12 " x 4 " Baxter
13 " x 5 " Sebastian
14 " x 6 " G. & B.
16 " x 6 " Blaisdell
18 " x 8 " New Haven
Lathes from 10 to 36 in. swing, both new and second-hand, constantly in stock — 105 lathes to select from

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14 in. crank, Walcott
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30 in. Fox.
Complete stock of new.

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10 inch sensitive, Fulton
15 " slid. hd., W. & R.
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5 " " Gardner
2 spindle adjustable, F. & B.
15 inch Burnham
3 spindle B. & D.
6 spindle turret, Quint
26 inch Prentice, S. H., B. G.
35 inch Blaisdell

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50 " board lift, P. & W.
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14 in. x 5 ft. Blaisdell. 14 in. x 5 ft. Putnam.
14 in. x 6 ft. Flather, with compound rest.
15 in. x 6 ft. Fitchburg.
16 in. x 6 ft. Flather, with compound rest.
16 in. x 6 ft. Blaisdell, with rise and fall rest.
16 in. x 6 ft. Reed, with rise and fall rest.
16 in. x 8 ft. Reed, with compound rest.
20 in. x 14 ft. Rahn. 21 in. x 7½ ft. Draper.
24 in. x 14 ft. Blaisdell. 30 in. x 24 ft. Johnson.
38 in. x 19½ ft. New Haven.

PLANERS.

20 in. x 20 in. x 4 ft. Lathe & Morse.
22 in. x 22 in. x 5 ft. Flather.
25 in. x 25 in. x 4 ft. Davis.
26 in. x 26 in. x 11 ft. Flather.
30 in. x 30 in. x 8 ft. Wheeler.
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60 in. x 50 in. x 18 ft. Betts, two heads.

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24 in. Hendey.
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20 in. Prentice, plain.
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Sensitive drills, 1, 2, 3 and 4 spindles.
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Vanderbeek universal miller.

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No. 2 B. & O., plain. No. 3, B. & O., complete.
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Fox turret lathe with chasing bar.

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Sellers cylinder boring machine.
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Electric crane, 6 ton, 25 ft. span.
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28 x 20 Harris.
20 in. Potter & Johnston turret lathe.
62 x 14½ New Haven, triple gr., in fine cond

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No. 1 Garvin universal.
No. 4 Garvin.
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No. 2 Pratt & Whitney hand.
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72 x 60 x 14 Betts.

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No. 1 Brown & Sharpe automatic.
14 in. Brown & Sharpe auto. turret lathe.
2 in. Cleveland automatic.
18 in. Davis & Egan screw machine.
No. 1½ Dreses Mueller screw machine.
24 in. x 7 Garvin turret lathe.
No. 2 Hartford automatic double spindle.
1⅝ in. Hartford automatic.
2⅝ Hartford automatic.
20 in. Potter & Johnson turret lathe.
16 x 5 Pratt & Whitney.
22 x 8 Lodge & Shipley screw machine.
Garvin hub forming machine.
No. 2½ Pratt & Whitney, 1¾ in.
No. 3 Pratt & Whitney, 2 in.
No. 3 Pratt & Whitney, 2¼ in.
No. 3 Pratt & Whitney, 2⅜ in.
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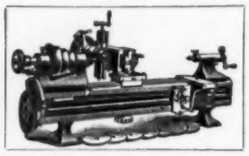

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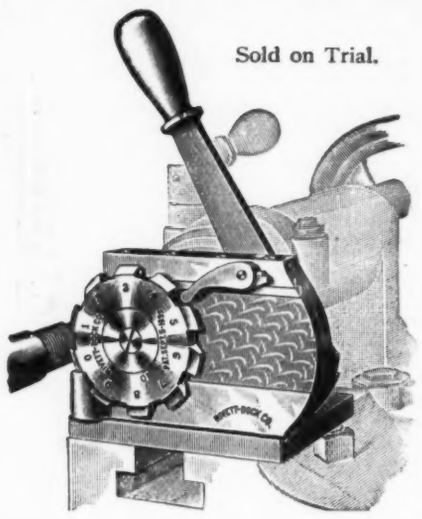

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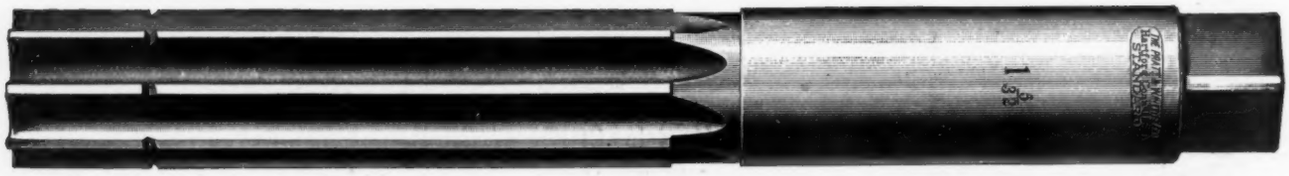

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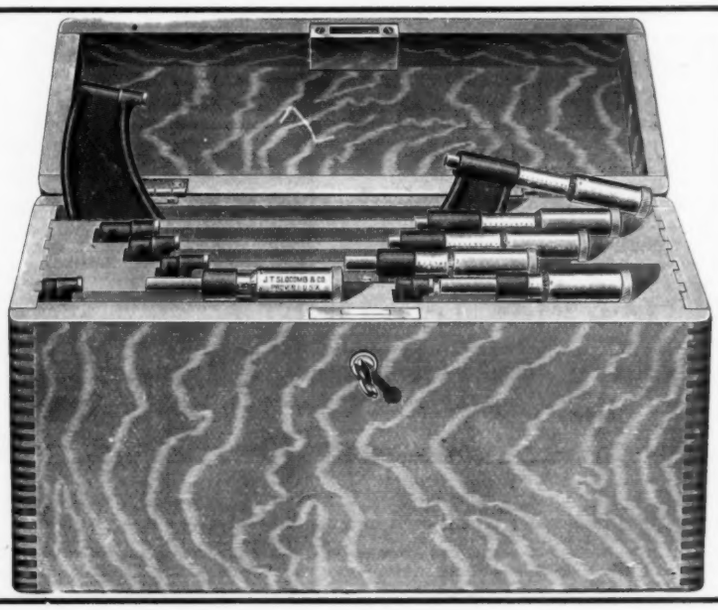

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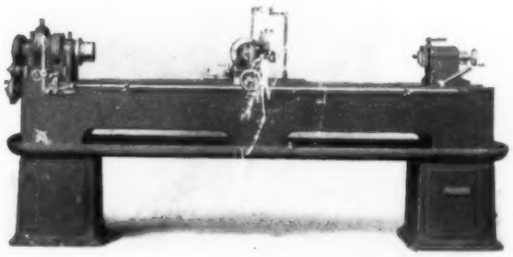

Made in two sizes: 6 x 14″ 6 x 80″

See page 2 for samples of work done on this machine.

6 x 80″ Thread Milling Machine.

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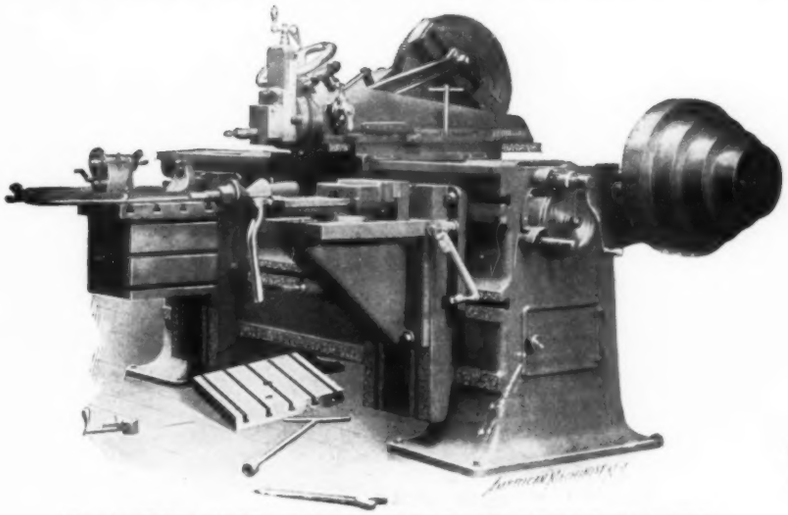

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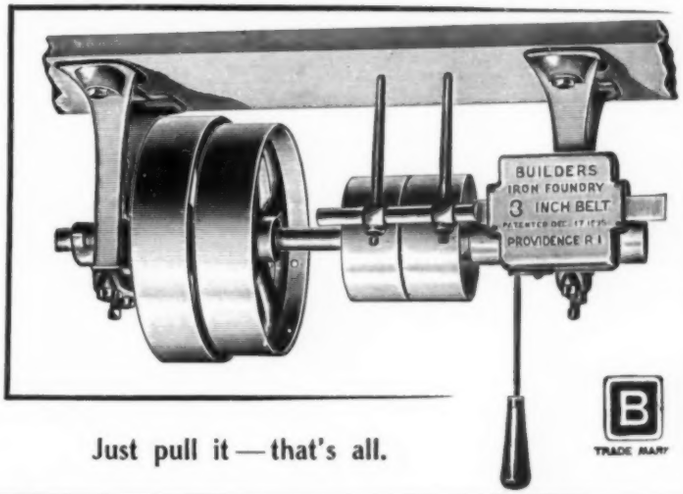

Just pull it — that's all.

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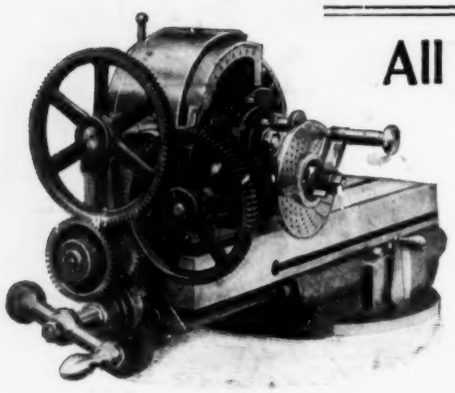

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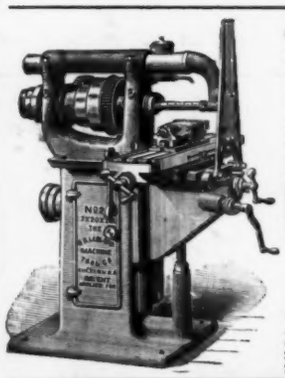

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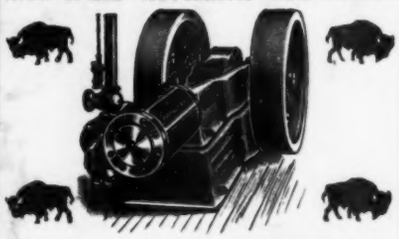
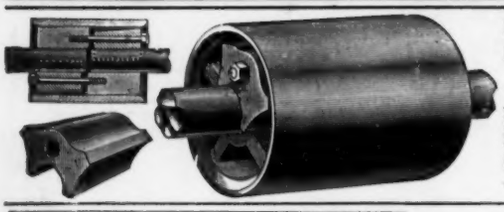


BUFFALO FORGE COMPANY,

BUFFALO, N. Y.



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